DRAFT FINAL
INTERIM REMEDIAL MEASURES
WORK PLAN
EKCO HOUSEWARES FACILITY
MASSILLON, OHIO

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INTRODUCTION

This work plan has been prepared by Roy F. Weston, Inc. (WESTON®) on behalf of American Home Products Corporation (AHPC) and addresses the Interim Remedial Measures (IRM) activities proposed for the EKCO Housewares, Inc. (EKCO) facility in Massillon, Ohio. AHPC retained WESTON in 1990 to conduct a Resource Conservation and Recovery Act (RCRA) Facility Investigation and a Corrective Measures Study (RFI/ CMS) for the EKCO facility. The RFI portion of the RFI/CMS was conducted from April 1991 through March 1992. All work performed during the RFI was based on the requirements presented in the RFI/CMS Work Plan that was approved in January 1991 by the U.S. Environmental Protection Agency (EPA), Region V. The Final RFI and Draft CMS reports were submitted to EPA in August and September 1993, respectively. The RFI report was approved, with modifications, by EPA on 3 November 1993. Review and approval of the CMS are pending. The IRM activities included in this work plan have been previously discussed in both the RFI and CMS reports, as well as in a May 1992 correspondence and an April 1993 meeting, both between AHPC/WESTON and EPA Region V. The proposed IRM activities are as follows:

- Rehabilitating six on-site wells by properly sealing the well casings against confining layers present in the side walls of the boreholes. This rehabilitation will eliminate interaquifer communication and contaminant migration between the shallow overburden aquifer and the bedrock aquifer beneath the site.
- Abandoning shallow overburden monitor well D-4-30 by overdrilling and grouting the borehole in accordance with the Ohio Department of Natural Resources (ODNR) regulations for well abandonment. Because of the siltation problems associated with the poor condition of the wellhead seal and well riser, the agency has agreed with the need for abandonment.
- Following completion of rehabilitation activities, monitoring the groundwater levels in all aquifer units to assess the extent to which the pumping of the site recovery wells continues to affect the aquifer gradients and capture zones. Conservatively, it is anticipated that additional recovery wells may be required in the shallow water-bearing zones as a result of the well rehabilitation activities.

As part of a packer testing program conducted during the RFI in April 1991, a casing seal test was performed on monitor well R-2. The results of this test indicated that the casing seal was leaking and allowing shallow aquifer groundwater to enter the well and migrate downward into the open borehole section of the well. Additionally, the packer testing results in the open borehole portions of wells R-1, R-2, and R-4 indicated that a downward hydraulic gradient existed in each of these wells, a finding consistent with the sitewide bedrock geology. The problems associated with leaking or deteriorated bedrock well casings at the site are as follows:

- The leaking casing seats provide conduits for groundwater to migrate from the shallow overburden water-bearing unit that currently contain approximately 3 mg/L of volatile organic compounds (VOCs) in some areas, to the bedrock water-bearing unit that currently contains approximately 1 mg/L of VOCs in some areas. The bedrock wells proposed for rehabilitation are all located in close proximity to the on-site VOC source areas identified during either the RFI or previous investigations.

- The mixing of the overburden and bedrock groundwater at the leaking wells is potentially extending the time required for cleanup of the bedrock aquifer and is causing analytical groundwater sampling data for the bedrock unit to be nonrepresentative.

- The artificial hydraulic connection between the overburden and the bedrock causes inaccuracies in water-level measurements to occur in both water-bearing zones. A more efficient shallow aquifer recovery system may be designed and implemented once natural hydraulic isolation between water-bearing units is restored.

Two shallow aquifer groundwater recovery alternatives are described in the Draft CMS report (WESTON, 1993), which address the potential for the reduction of hydraulic control in the shallow aquifer due to the rehabilitation of the well casings. Should reduction of hydraulic control be extensive, additional recovery wells will need to be established as soon as possible.

1.1 SITE BACKGROUND

1.1.1 Site Location

The EKCO facility occupies approximately 13 acres in the town of Massillon, Stark County, Ohio (Figure 1-1). The area surrounding the site is largely urban and industrial. Land use to the northwest is more rural with a larger proportion of open space. The EKCO property is triangular and lies an estimated 1,500 ft west of the Tuscarawas River. The facility is bordered to the north by Newman Creek, while Conrail and the Baltimore and Ohio railroads border the EKCO property to the west and east, respectively. The Baltimore and Ohio Railroad has numerous spurs and sidetracks adjacent to the EKCO plant, which are used for the storage of railcars and track maintenance vehicles.

A variety of businesses are located adjacent to the EKCO plant. These include Ohio Packaging (paper) to the south, sand and gravel quarries to the west and northwest, Carter Lumber (retail) and American Drain Pipe (concrete pipe manufacturing) to the north, and the Ohio Water Service (public water supply) waterworks to the east. An inactive municipal landfill exists just east of the Ohio Water Service facility.

1.2.2 Site History

In the 1940s, the EKCO facility in Massillon manufactured aluminum and stainless steel cookware. By 1951, with the United States involved in the Korean Conflict, the plant began manufacturing 90-mm and 105-mm shell casings for the military. The resulting increase in production necessitated the drilling of two production wells (W-1 and W-2) at the facility. In 1953, a sewer was constructed to carry plant waste to a discharge point along Newman Creek. At approximately the same time, a surface impoundment was constructed along the northern property boundary adjacent to Newman Creek. Sludge resulting from waste treatment activities was discharged to the surface impoundment.

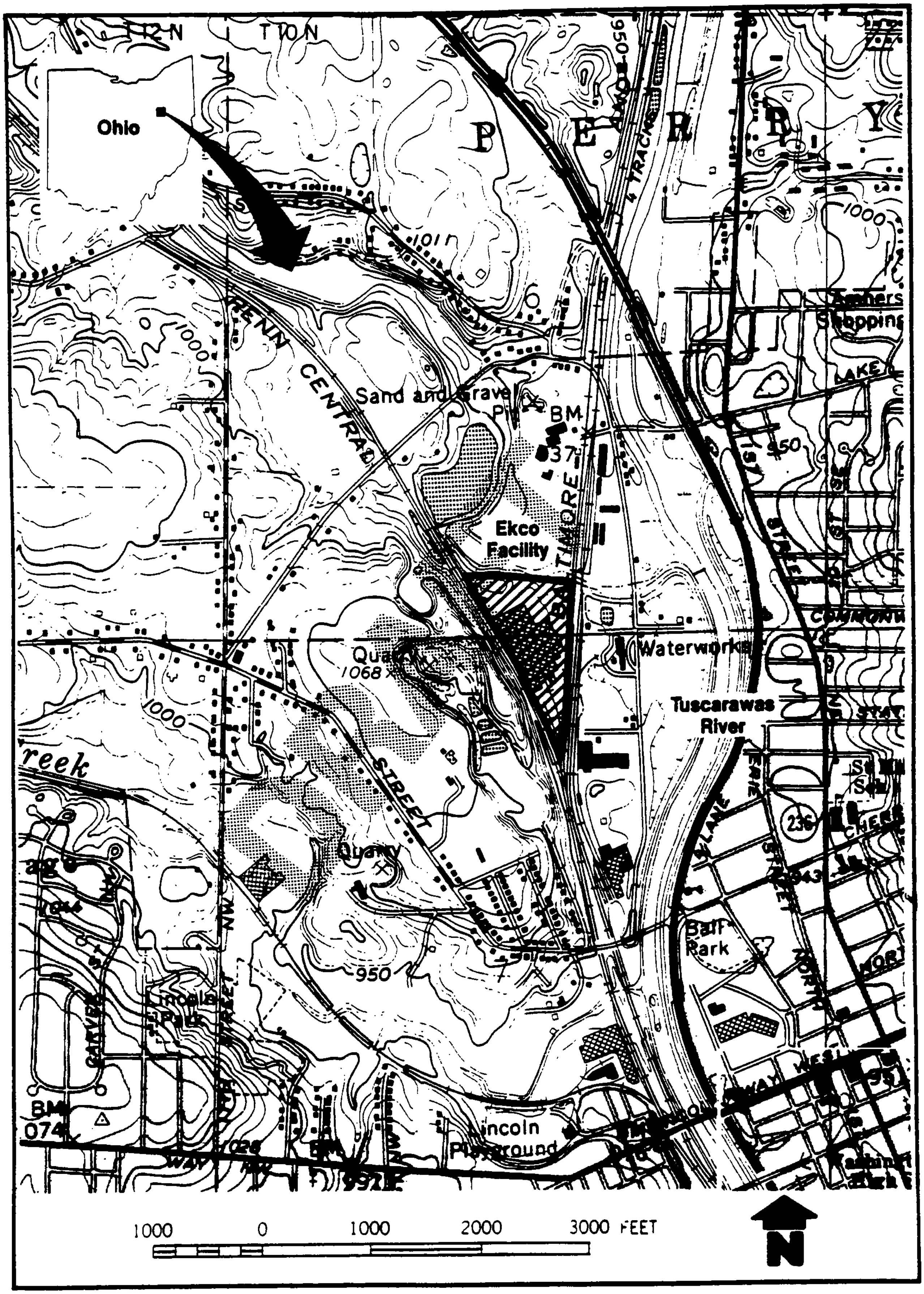

FIGURE 1-1 SITE LOCATION MAP
EKCO HOUSEWARES, INC., MASSILLON, OHIO
(Ref. 7.5 Minute Massillon Quad, Ohio, 1978)

During 1954, EKCO began coating cookware manufactured at the facility. Solvents, primarily trichloroethylene (TCE) or 1,1,1-trichloroethane (1,1,1-TCA), were used to clean the products prior to coating. Sometime during the mid 1960s, EKCO stopped using TCE; however, its use was reinitiated in the 1980s.

In 1965, AHPC acquired EKCO Housewares. Porcelain and Teflon coating units at the EKCO facility were installed in 1967. In 1969, with the development of new National Pollutant Discharge Elimination System (NPDES) regulations and permit requirements, the surface impoundment was approved and permitted by the State of Ohio to discharge waste products associated with plant activities. These waste products have included:

- Deionizers from copper coating operations (hydrochloric acid and sodium hydroxide).
- Washings and waste material from manufacturing porcelain/Teflon-coated aluminum cookware (aluminum frit, various pigments; inorganic oxides of lead, cadmium, selenium, and cobalt).
- Alkaline washer fluids used to clean aluminum cookware.

In July 1974, NPDES Permit C-3094BD was issued to the EKCO facility. As the 1970s progressed, EKCO discontinued the manufacture of aluminum and porcelain cookware, and use of the lagoon ceased in 1977. By the end of 1978, all copper-coating operations had ended and the principal products manufactured at the facility consisted of pressed and coated nonstick bakeware.

Correspondence between EKCO and the Ohio Environmental Protection Agency (OEPA) identified a solvent spill that had occurred between 1979 and 1980 as the only major recorded spill at the facility. The spill was in the vicinity of process water well W-10. Neither the exact location nor the extent of the spill was documented. It should be noted that W-10 is located in a sump and is covered with a grate flush with the plant floor, which makes the well head vulnerable to floor drainage. In 1992, EKCO reported to EPA a 50-gallon spill of 1,1,1-TCA on the western side of the building. A description and location map of the EKCO facility is included in Figure 1-2.

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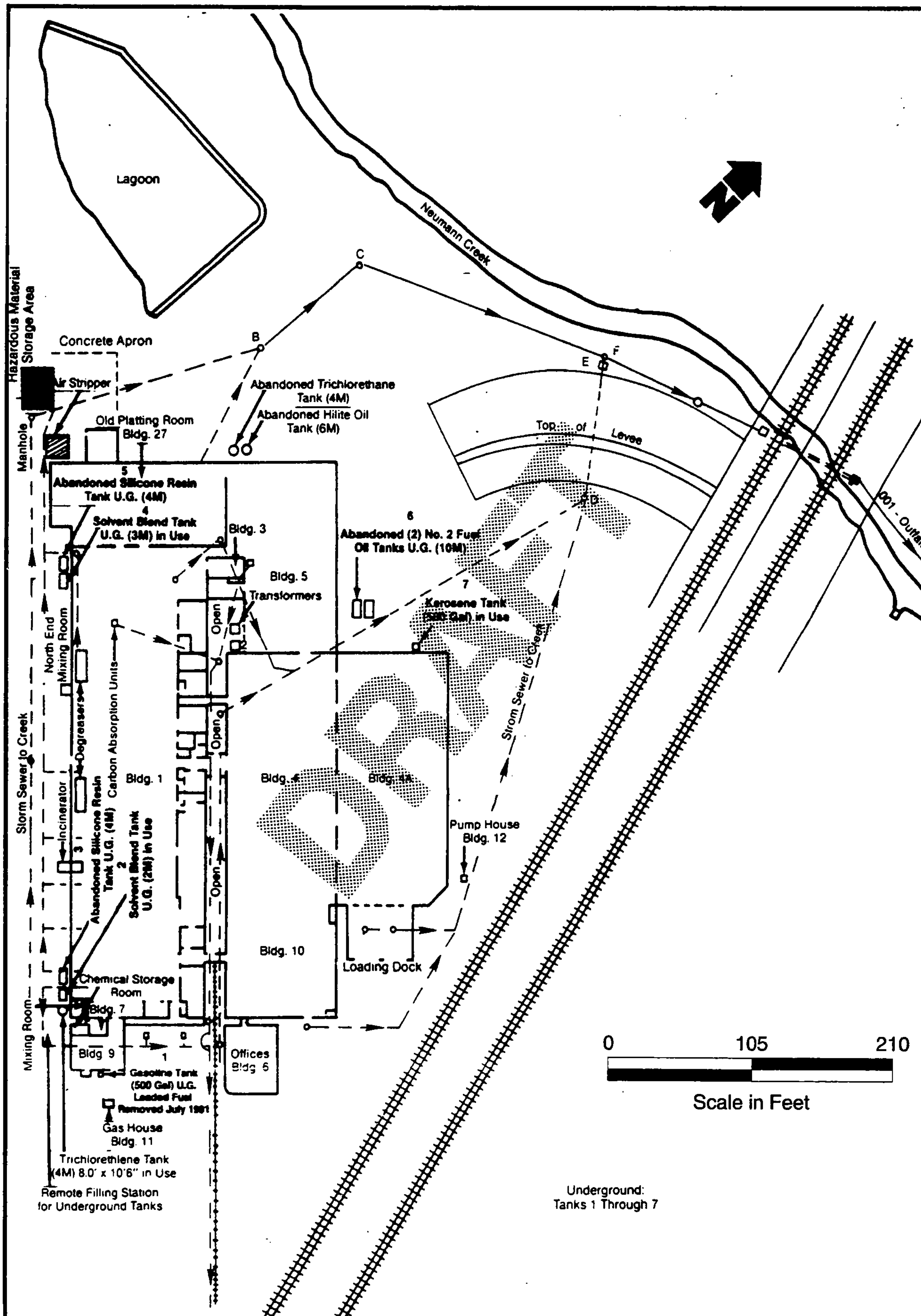

FIGURE 1-2 FACILITY DESCRIPTION AND LOCATION
EKCO HOUSEWARES, INC., MASSILLON, OHIO

The surface impoundment was reactivated in 1980 under the existing NPDES permit and received degreaser filter water until mid-1984. In 1984, AHPC sold EKCO Housewares to the EKCO Group.

In March 1984, when the plant applied for a renewal of its NPDES permit, an analysis of on-site well water for VOCs was required. The analysis indicated the presence of 1,1,1-TCA and TCE. This discovery resulted in the subsequent investigations at the EKCO site. These investigative activities are summarized in Subsection 2.1 of this work plan.

EKCO continues to manufacture pressed and coated nonstick bakeware at the Massillon facility. A silicon-based compound is presently used to coat the bakeware to create the non-stick surface.

1.1.3 Environmental Setting

1.1.3.1 Climate and Topography

Information obtained from the Akron/Canton office of the National Weather Service reveals an average precipitation rate of 35.90 inches per year based on records for a 30-year period, 1951 to 1980 inclusive. The average yearly snowfall is 37.5 inches and the mean annual Class A pan evaporation is approximately 40 inches per year.

The majority of the EKCO facility is generally flat. The northern edge of the facility slopes steeply toward Newman Creek. Surface water runoff at the facility discharges to Newman Creek by two pathways: surface runoff on the northern part of the facility flows directly into Newman Creek, and surface discharge from the remainder of the facility is routed through the storm sewer system, which discharges into Newman Creek through Outfall 001 located just east of the Baltimore and Ohio Railroad tracks. A small northern portion of the facility is located within the 100-year floodplain of Newman Creek.

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1.1.3.2 Regional Geology

The unconsolidated materials that cover most of Stark County, Ohio, are highly variable glacial drift and outwash deposits that range in composition from fine clay particles to boulders. The glacial drift thickness generally ranges from less than 25 ft to approximately 100 ft. In the areas of buried valleys, this unconsolidated material can exceed 500 ft in thickness (ODNR, 1972).

Underlying the glacial drift and outwash deposits are sedimentary rocks of the Pennsylvanian, Mississippian, and Devonian geologic systems. These bedrock formations dip generally to the southeast at approximately 20 to 40 ft per mile and consist of sandstone and shale with some interbedded coal and occasional thin limestone units (Cross, 1959). Table 1-1 summarizes the generalized stratigraphic sequence for the Middle Tuscarawas River Basin.

1.1.3.3 Regional Hydrogeology

The western portion of Stark County lies within the Middle Tuscarawas River Basin. The units capable of providing sufficient quantities of groundwater to domestic, commercial, and municipal wells underlying this basin include the unconsolidated deposits of sand and gravel and the consolidated layers of sandstone, shale, limestone, and coal. Yields may range from less than 1 gallon per minute (gpm) from clay and shale deposits to more than 1,000 gpm from thick, permeable sand and gravel deposits (Schmidt, 1962). Figure 1-3 illustrates the availability and yield of groundwater in the western portion of Stark County.

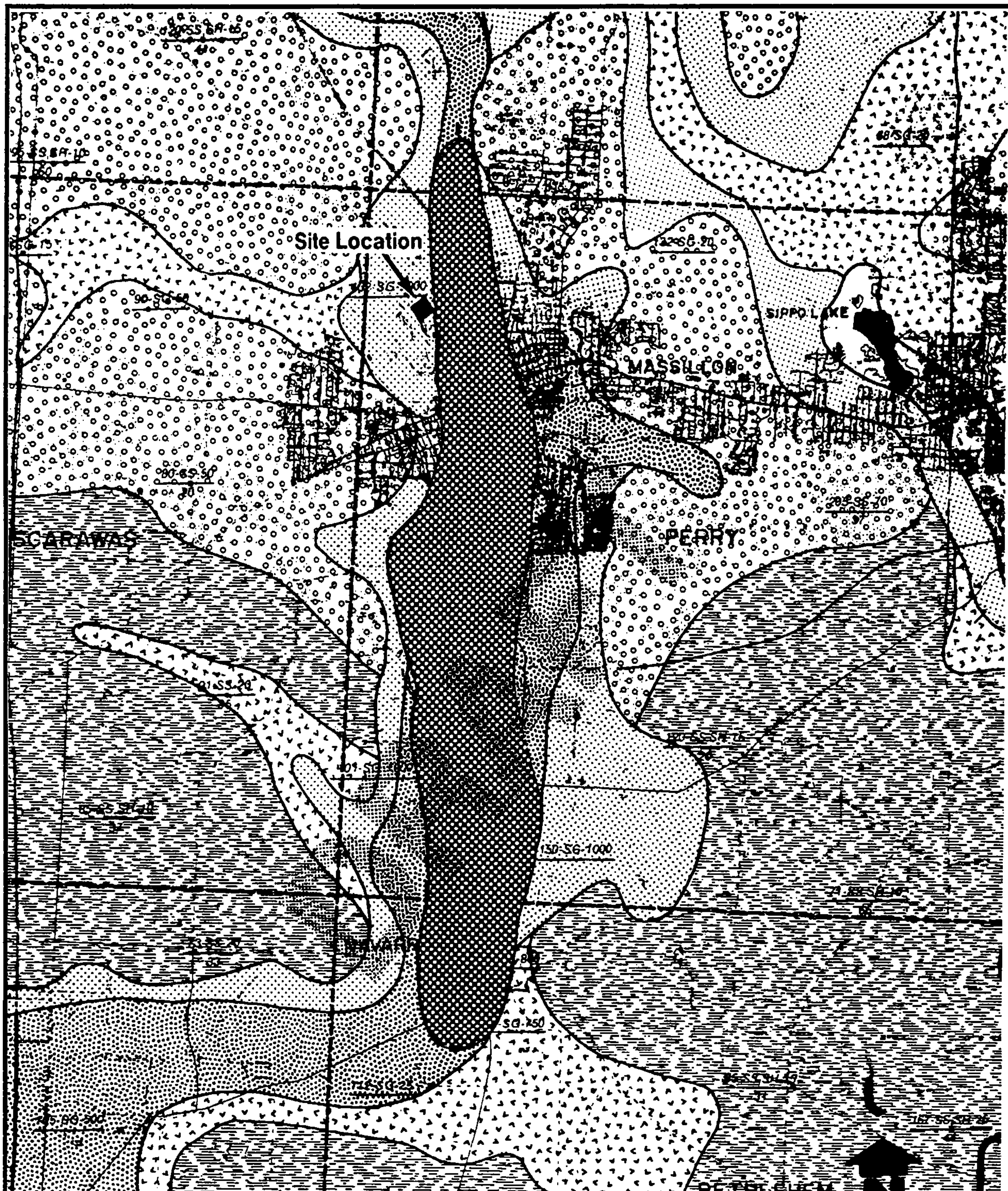
The outwash deposits beneath the floodplain of the Tuscarawas River have the greatest potential for the development of large groundwater supplies in this basin. Yields from properly developed wells in this unit range from 500 to more than 3,000 gpm. The majority of these wells are developed at depths less than 160 ft (Schmidt, 1962).

Table 1-1

Generalized Stratigraphic Sequence in the Middle Tuscarawas River Basin

Series or System	Group or Formation	Character of Material	Water-Bearing Characteristics
Quaternary		Clay, silt and alluvium deposited on the flood plains of the principal valleys.	Generally a poor source of groundwater because of limited thickness and absence of coarse materials.
Quaternary Pleistocene		Interbedded and interlensing layers of sand, gravel, and clay deposited in the buried valleys by glacial meltwaters. Thick layers of silt and clay interbedded with relatively thin lenses of sand and gravel.	Quantity of available water depends on character of material and source of recharge. Properly developed wells yield in excess of 1,000 gpm. Drilled wells developed in the sand and gravel yield 5 to 15 gpm.
Pennsylvanian	Pottsville	Alternating layers of shale, sandstone, limestone, and coal. Thin to thick, coarse-grained sandstone.	Yields sufficient water for farm and domestic needs. Domestic, farm, and industrial supplies are readily available. Yields of as much as 500 gpm reported. However, regional yield seldom exceeds 15 gpm.
Mississippian		Alternating layers of sandstone and shale.	Farm and domestic supplies are readily developed. If thick shale formations predominate, meager groundwater supplies are developed.

Source: Schmidt, 1962.



Legend

- = Permeable Sand and Gravel Deposits in Deep Buried Valleys. Can Yield More Than 500 gpm.
- = Valley Fill Containing Sand and Gravel Deposits of Limited Thickness and Extent. Can Yield 10-30 gpm.
- = Permeable Sand and Gravel Deposits Not Traversed by Major Streams. Can Yield 100-500 gpm.
- = Interbedded and Interlensing Sand, Gravel, Silt and Clay. Can Yield 25-100 gpm.
- = Sandstones of the Pottsville Group. Can Yield 25-100 gpm.
- = Sandstones and Sandy Shales. Can Yield 10-30 gpm.

Scale in Miles

0 1 2 3 4

(Source: **Groundwater Resources of Stark County,** Alfred C. Walker, Ohio Department of Natural Resources.)

FIGURE 1-3 GROUNDWATER RESOURCES OF MASSILLON, OHIO

The bedrock underlying the glacial deposits in the basin consists of interbedded, thin to thick layers of sandstone, shale, coal, and occasional limestone. All of these are part of the Pottsville group of Pennsylvania age. Because of the vertical variations in lithology and, hence, permeability within the Pottsville formation in the area, groundwater wells reportedly range in depth from 46 ft to 500 ft. It has been reported that yields of groundwater range from less than 1 gpm to more than 500 gpm (Schmidt, 1962). The average domestic well is 170 ft deep and yields about 8 gpm. Yields of commercial and municipal wells developed in the sandstone units of the lower Pottsville formation are reported to range from 25 to 100 gpm (Walker, 1979); however, higher yields are possible, as evidenced by the recovery rates of the EKCO wells W-1 (about 230 gpm) and W-10 (about 300 gpm), which were each hydrofractured with 200 pounds of dynamite to increase yield.

1.1.4 Local Groundwater Usage

1.1.4.1 Ohio Water Service Municipal Wells

Currently, the Ohio Water Service Company (OWS) has seven active production wells (OWS-1, -2, -3, -5, -7, -8, and -9), and one well (OWS-4) that was taken off-line for municipal use and subsequently converted into an observation well. The OWS well field pumps approximately 7.5 million gallons per day (gpd) from the seven production wells. Individual wells are pumped at varying rates to maintain this production. Only three wells are normally run at any one time. When running, the rates at which OWS-1, -2, -3, -5, -7, -8, and -9 are pumped are approximately 2,800, 1,260, 350, 2,450, 2,100, 2,100, and 2,000 gpm, respectively. All of the OWS wells are reported to have been constructed with 50-ft screens at total depths of 150 to 160 ft and screened in the deep sand and gravel aquifer. The locations of the OWS wells are provided in Figure 1-4.

1.1.4.2 Private Wells

Approximately 50 domestic wells and three commercial wells are located within a 1-mile radius of the EKCO facility. No information is available on the depths or construction details of these domestic wells. The average depth of the three commercial wells is 225 ft. The location of these commercial wells is shown in Figure 1-4.

1.1.4.3 EKCO Production/Recovery Wells

There are currently two on-site production wells (W-1 and W-10) being used as both recovery wells and production wells in manufacturing processes at the facility. Groundwater from production wells W-1 and W-10 is treated in an on-site air stripper, then either routed to various plant processes or discharged to Newman Creek by an underground storm sewer. A layout of the storm sewer system is shown in Figure 1-2. W-1 is located near the southern corner of the building, and W-10 is about 800 ft north of W-1 and inside the building (Figure 1-5). Well W-1 is completed as an open hole well in bedrock to a total depth of 225 ft. At this location, shale was encountered at 25 ft, followed by a series of interbedded sandstones and shales. Construction details for W-10 are unavailable, but it is believed to be cased into bedrock at a depth of approximately 30 ft and completed as an open hole well in bedrock to a total depth similar to that of W-1.

While pumping at the site dates back to the 1940s, the current pump-and-treat recovery system began in February 1986 with the concurrence of OEPA. When the system was instituted, W-1 pumped 240 gpm and W-10 pumped 140 gpm. Available records indicate that these pumping rates were fairly constant through the first 2 years of the pump-and-treat program. During this time, flow rates reportedly varied about 10 to 15 gpm. In April 1988, the pumping rate of W-10 was increased to 255 gpm, while the rate of W-1 remained fairly constant at 245 gpm. Plant records indicate that the pumping rate of W-10 was increased to 305 gpm in May, 330 gpm in August, and 375 in September of 1988. The W-1 pumping rate remained constant during 1988 at 245 gpm. In December 1988, the pumping rate of W-10 was 345 gpm and 245 gpm for W-1. Total VOC levels in the recovered groundwater were 18 mg/L in 1986. By 1987, total VOC levels had dropped to 8 mg/L. During 1990, 1991, and 1992, total VOC levels were 1,426 μg/L, 1,278 μg/L, and 1,459 μg/L, respectively.

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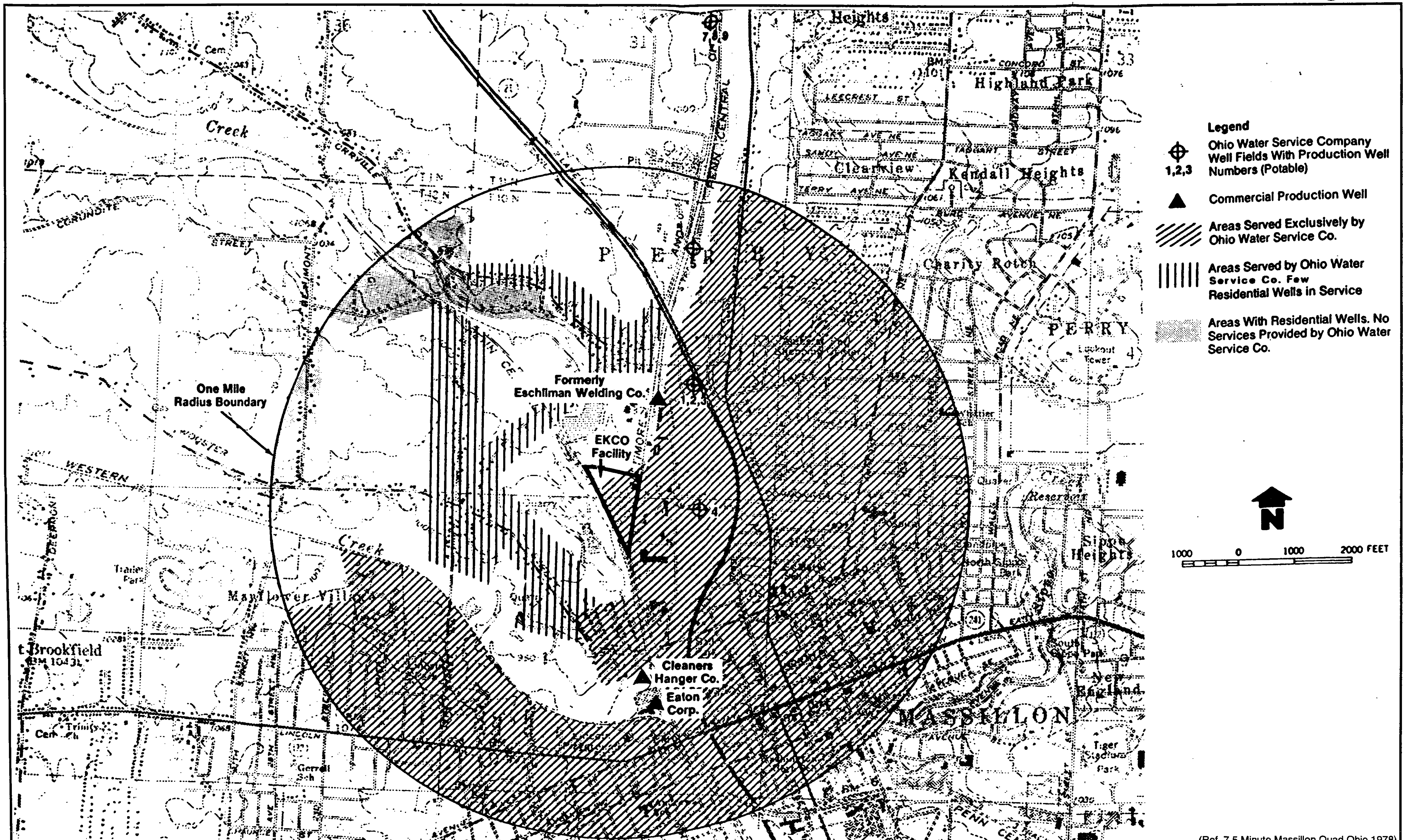

FIGURE 1-4 WATER SUPPLY MAP WITHIN ONE MILE RADIUS OF THE EKCO FACILITY BOUNDARY

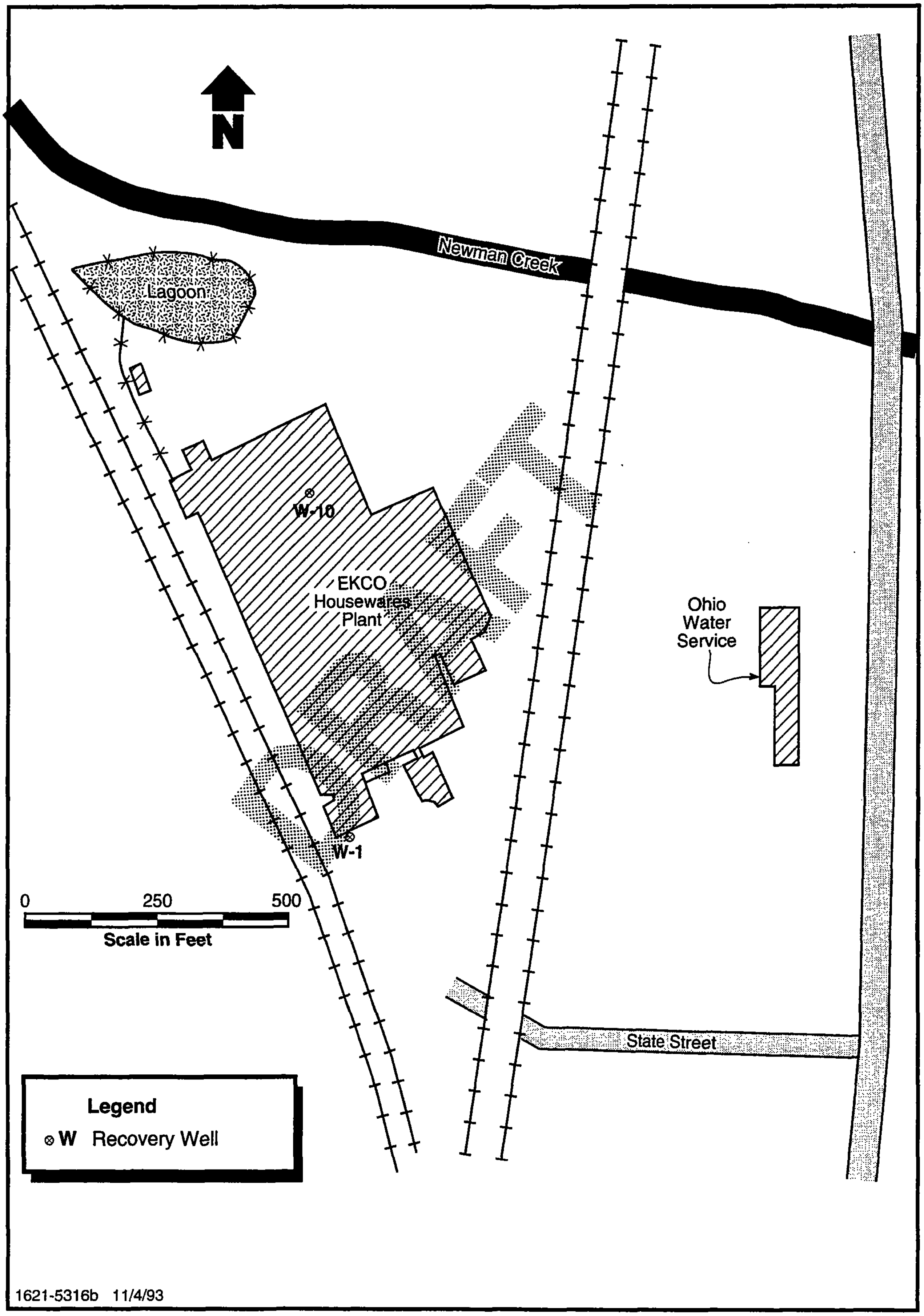

FIGURE 1-5 EKCO FACILITY RECOVERY WELLS

Four water-bearing units have been identified in the area of the EKCO facility: the shallow, the intermediate, the deep overburden units, and the bedrock unit. Of these, only the deep overburden aquifer is not present directly below the EKCO facility. Groundwater contour maps of the shallow, intermediate, and bedrock water-bearing units indicate that the groundwater in these units is flowing toward production wells W-1 and W-10. Because all of the groundwater at the facility in these three units is flowing toward production wells W-1 and W-10, any dissolved VOCs that exist in the groundwater at the facility are being captured by the site production wells and treated by the on-site air stripper system.

SECTION 2

DATA COLLECTION

This section of the work plan describes findings of the RFI as well as those of previous environmental investigations that have been conducted at the EKCO facility that relate to the IRM activities proposed in this work plan.

In 1984, with the discovery of 1,1,1-TCA and TCE in the groundwater beneath the plant, EKCO initiated a number of activities to investigate the problem, which culminated with the 1993 RFI and, ultimately, the CMS in September 1993. The reports that detail the scope of work and results of these investigations conducted between 1984 and 1992 are as follows:

- EKCO Closure Plan Presentation - Memorandum Draft (Floyd Brown Associates, November 1986).
- *Interim Measures Report for EKCO Houseware, Inc., Massillon, Ohio* (WESTON, February 1988).
- *Groundwater Quality Assessment Plan for EKCO Housewares, Inc., Massillon, Ohio* (WESTON, March 1988).
- *Groundwater Quality Assessment Report for EKCO Housewares, Inc., Massillon, Ohio* (WESTON, May 1989).
- *RCRA Facility Investigation Report for EKCO Housewares, Inc., Massillon, Ohio* (WESTON, August 1993).

2.1 NATURE AND EXTENT OF CONTAMINATION

2.1.1 Source Identification Summary

Based on soil borings advanced in 1988 and 1991, the following three VOC source areas were identified (see Figure 2-1):

- Tank area at southwestern end of plant.
- Sump at production well W-10.
- Tank area at northern end of plant.

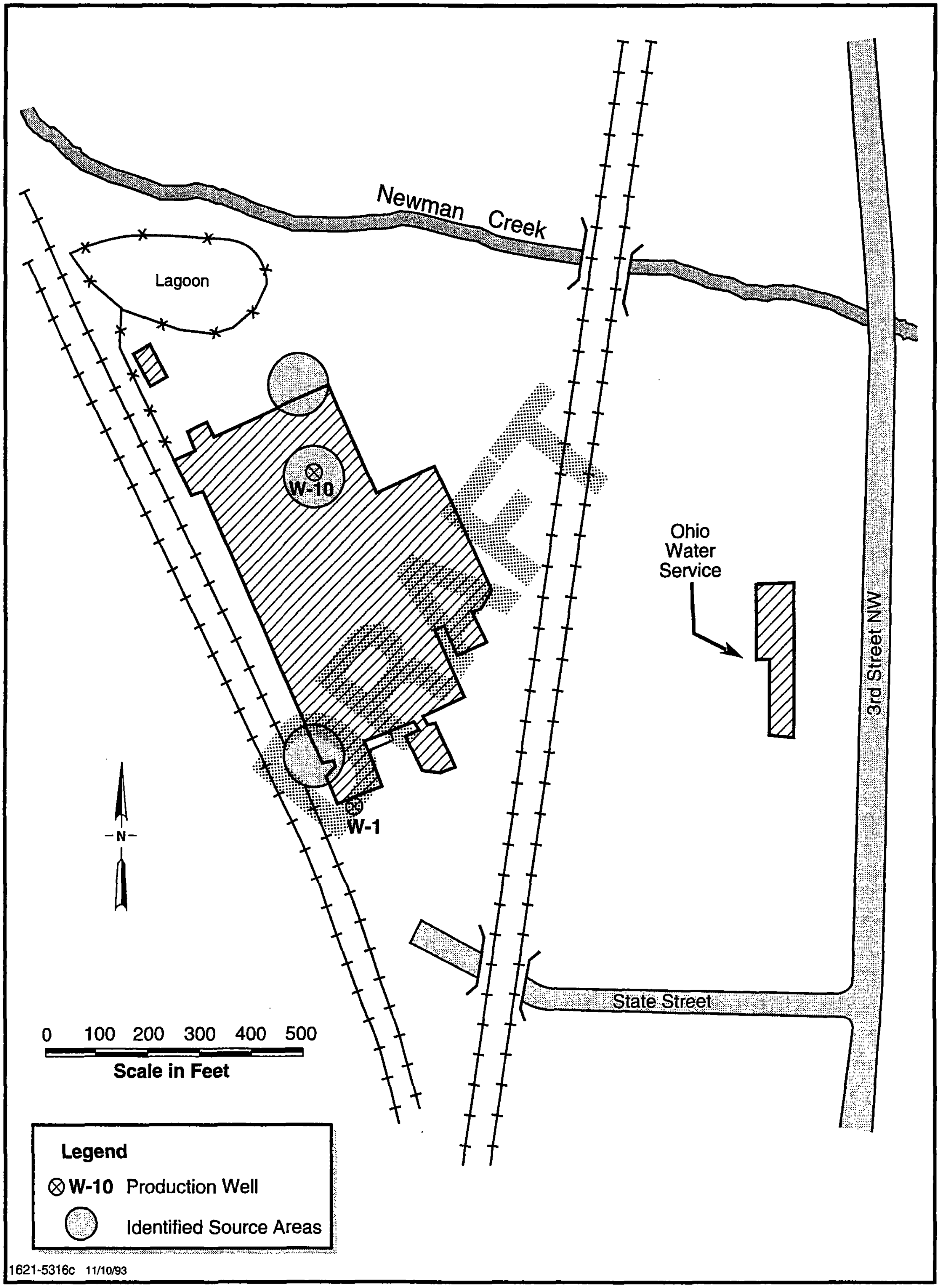

FIGURE 2-1 VOC SOURCE AREAS IDENTIFIED DURING THE RFI

TCE was the primary constituent detected at the tank area at the southwestern end of the plant. TCE contamination was detected at concentrations of 140 ppm and 2 ppm in two of the borings drilled in this area. In the tank area at the northern end of the building, TCE and dichloroethene (DCE) were the primary constituents detected. TCE was detected at all depth intervals in borings installed at the northern end of the building. DCE was detected at 34 ppm in one boring installed through the floor of the building adjacent to the sump at well W-10.

2.1.2 Groundwater Geochemical Summary

Groundwater sampling was conducted at the EKCO site in December 1988, September 1991, and March 1992. The monitor wells used are shown in Figure 2-2. In addition to these three sampling events, selected wells have been sampled quarterly since 1989 as part of the lagoon closure. Historically, groundwater sampling has been conducted for both VOCs and metals.

The VOCs detected in the groundwater were predominantly TCE, 1,1,1-TCA, and their respective breakdown products. The results indicate that high concentrations of TCE and 1,1,1-TCA occur in the shallow groundwater near the source area north of the plant near well D-4-30, in the intermediate groundwater at well I-2, and in the bedrock groundwater near wells W-10, R-1, and R-2. The percentage of breakdown products increases with increasing distance from the source areas at wells W-10 and D-4-30. Any dissolved VOCs that exist in the groundwater at the site are being recovered by the site production wells W-1 and W-10 and are being treated by the on-site air stripper system. These findings suggest that the primary area of concern with respect to interaquifer communication, is in the western half of the site where source areas in soils and elevated shallow aquifer contamination are present. As shown in Figure 2-1, the IRM activities are proposed for the bedrock wells in these areas of concern.

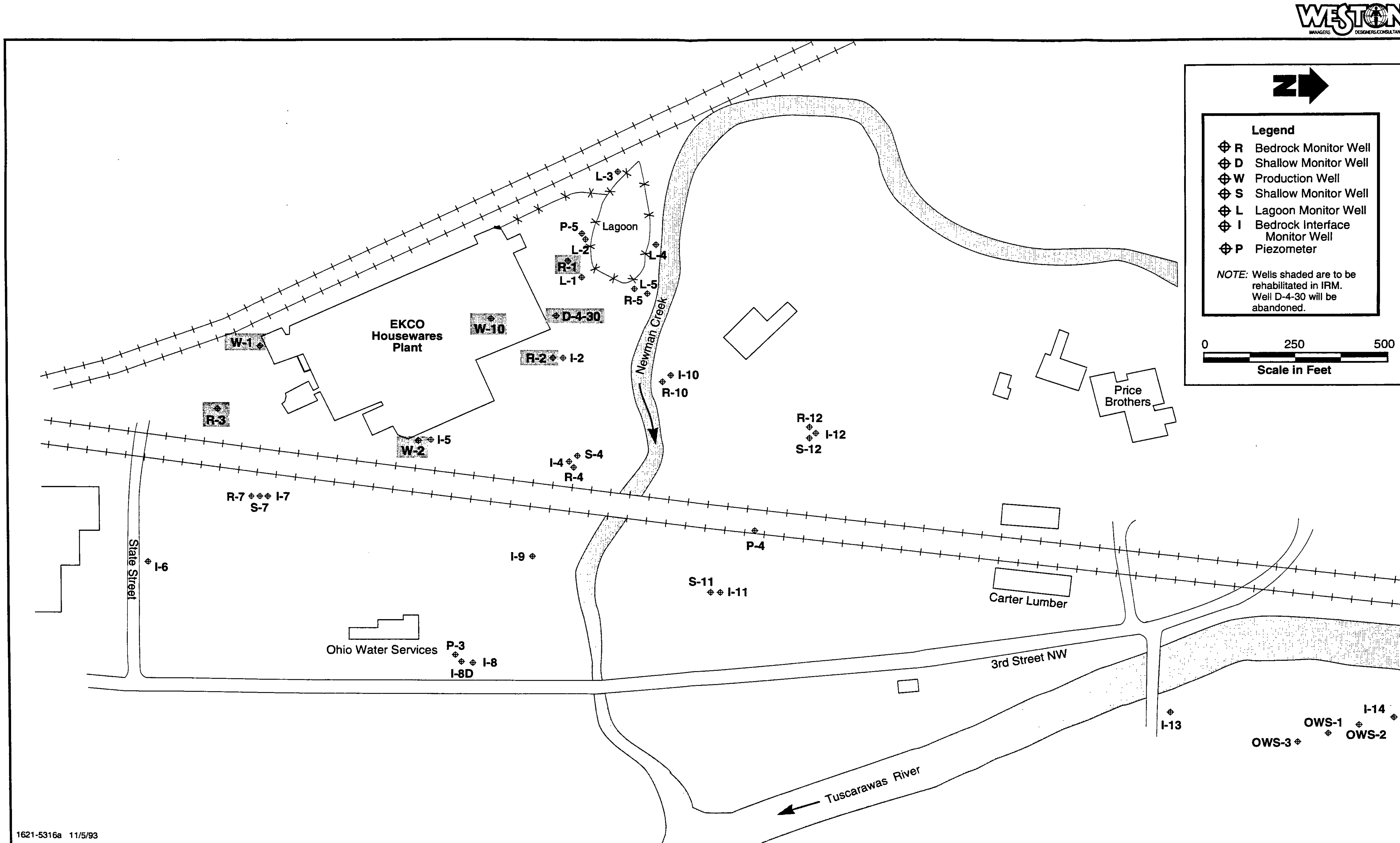

**FIGURE 2-2 MONITOR WELL LOCATION MAP
EKCO FACILITY, MASSILLON, OHIO**

2.2 SITE GEOHYDROLOGIC CONDITIONS

2.2.1 Geology Summary

The EKCO facility is situated on the western flank of a glacial valley that extends to the north and south and was carved from Pennsylvanian age sedimentary rocks during the Pleistocene glaciation. The glacially deposited sediments form a thin veneer 15 to 30 ft thick in the western half of the site where the depth to bedrock is shallow. The sediments infill towards the glacial valley to the east, reaching a maximum on-site thickness of approximately 110 ft at the eastern property boundary. Based on the drilling of the on-site overburden monitor wells and soil borings, the glacial materials encountered in the western portion of the facility were identified as high permeability sand and gravel units separated by low-permeability silt and clay units.

Underlying the glacial sediments, bedrock is encountered at its highest elevation in the northwestern portion of the site and slopes to the east at an approximate 17° angle. The slope of the bedrock surface is interpreted as an erosional feature caused by the past glaciations that deposited the overburden materials. The bedding is nearly flat-lying and has undergone little if any folding or faulting. Bedrock encountered at the site consists of four interbedded layers. The shallowest bedrock unit encountered consists of an interbedded low-permeable shale and argillaceous sandstone that is underlain by a high-permeability, well-sorted sandstone. The sandstone unit is the primary bedrock water-bearing unit at the site. Below the sandstone is another low-permeability interbedded shale and argillaceous sandstone unit that is directly underlain by shale.

The bedrock stratigraphy beneath the site was determined from the results of geophysical logging, packer testing, driller's logs, and regional data from the U.S. Geological Survey (USGS). Figures 2-3 and 2-4 show generalized geologic cross-sections of the stratigraphic units beneath the site.

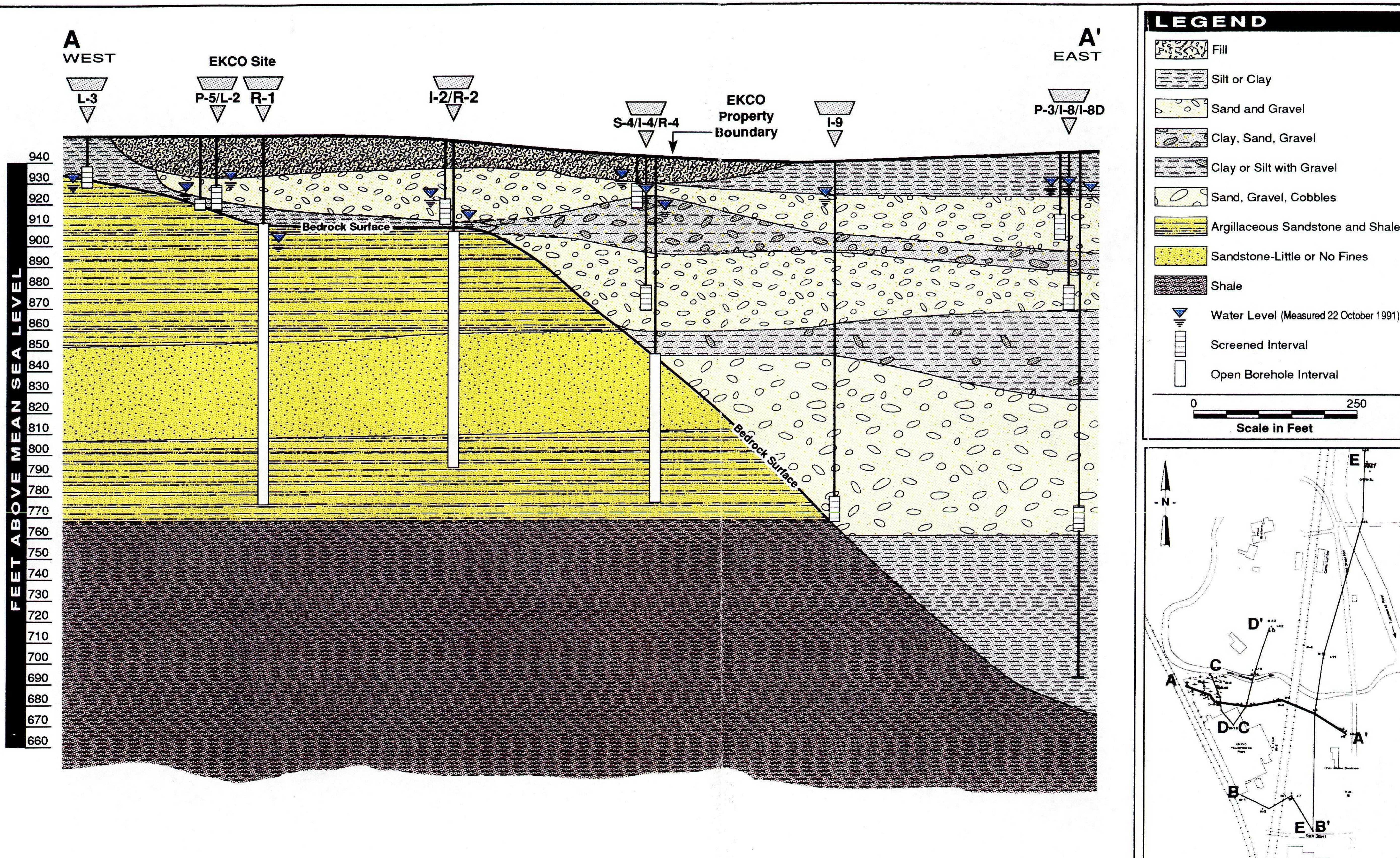

FIGURE 2-3
GEOLOGIC CROSS SECTION A-A' AT THE EKCO HOUSEWARES PLANT, MASSILLON, OHIO

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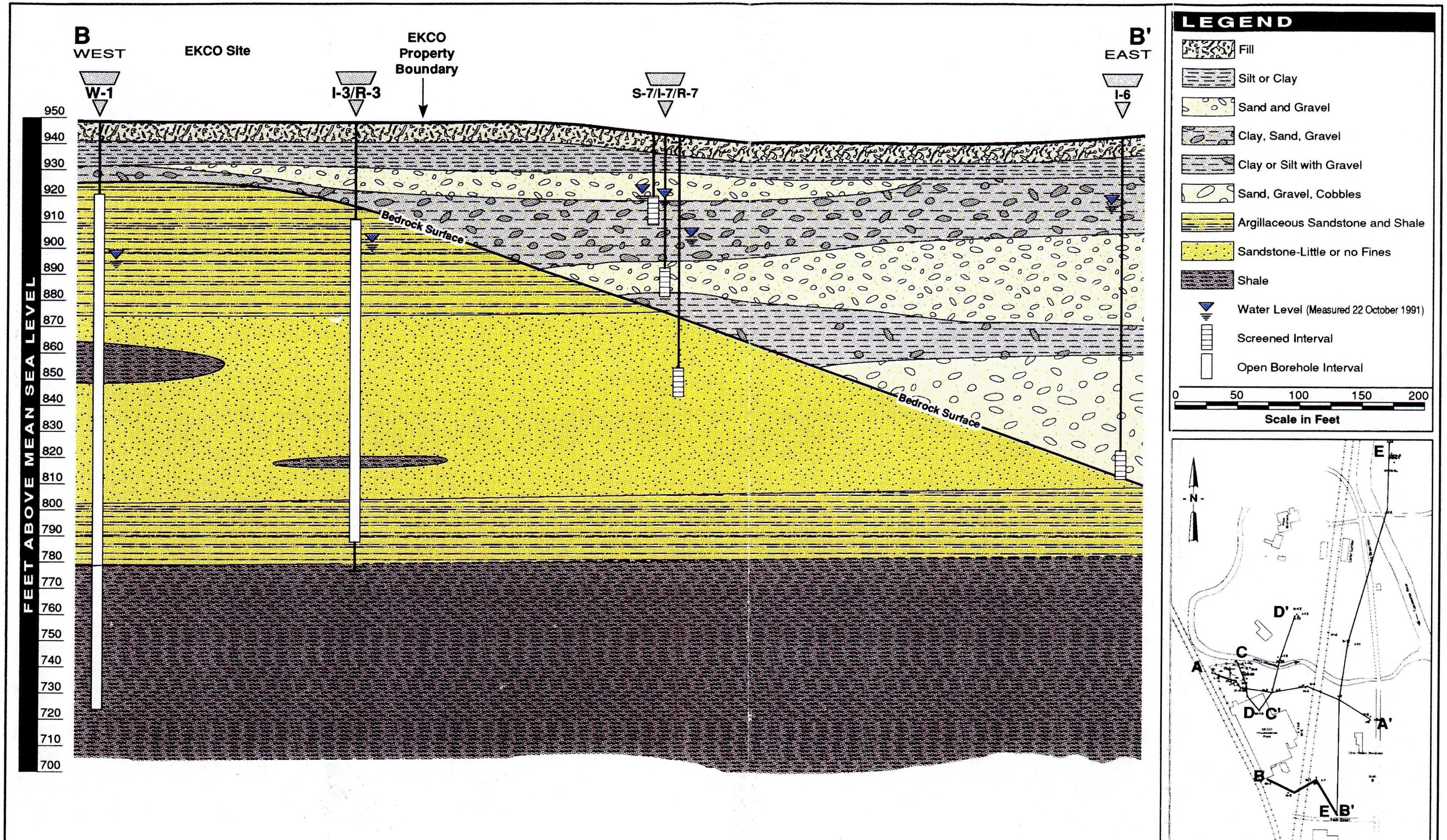

FIGURE 2-4
GEOLOGIC CROSS SECTION B-B'
AT THE EKCO HOUSEWARES PLANT,
MASSILLON, OHIO

1621-5316d 11/5/93

2.2.2 Hydrogeology Summary

The permeable hydrostratigraphic units present in the western half of the site are shallow sand and gravel, intermediate sand and gravel, and sandstone bedrock. These high-permeability units are separated by low-permeability clay and silt or shale and argillaceous sandstone. In general, the sand and gravel and the sandstone units act as the primary medium for groundwater flow, and the low-permeable silt, clay, shale, and argillaceous sandstone act as barriers to vertical groundwater flow; however, variations in permeability occur locally.

Results from the packer testing conducted in bedrock wells R-1 and R-2 demonstrated the confining capacity of the shale beds that overlie the productive sandstone unit in each of these wells. During the pumping phase of each test, the hydraulic heads above and below the packers (set across shale beds) did not change. In addition, the static water levels within the straddled zones were considerably higher than the bottom of the overlying shale beds for all five of the tested zones, indicating that the overlying shale units were causing the test intervals to be under semiconfined conditions. A comparison of the specific capacities obtained from the packer tests also serves to demonstrate the low permeability of the argillaceous sandstones. The productive sandstone in wells R-1 and R-2 provided measured specific capacities of 1.82 and 1.80 gallons per minute per foot (gpm/ft), whereas the argillaceous sandstones provided significantly measured specific capacities ranging from 0.0069 and 0.06 gpm/ft.

EKCO currently uses two sandstone bedrock production wells (W-1 and W-10), pumping at a combined total of approximately 600 gpm to both provide water for the manufacturing facility and act as groundwater recovery wells. Groundwater contour maps for the site indicate that the pumping of the EKCO production wells W-1 and W-10 appreciably affects the groundwater flow in the shallow, intermediate, and the bedrock water-bearing zones. A drawdown cone exists in these three units around wells W-1 and W-10. As a result of the pumping, the groundwater in the shallow, intermediate, and bedrock water-bearing zones under the entire site is flowing directly toward production wells W-1 and W-10, and does not flow off-site.

The 40-to-50-ft thick sequence of alternating shales and argillaceous sandstones that overlie the productive sandstone unit beneath the site would be expected to provide a natural barrier to vertical groundwater flow; however, site recovery wells W-1 and W-10 hydraulically control the groundwater flow directions in the shallow aquifer units on-site despite being open only to the bedrock water-bearing units. In addition, elevated contaminant concentrations in the bedrock wells in the western half of the site appear to indicate that the low-permeability units overlying the productive sandstone may have been breached. As a consequence of these findings, a falling head/casing seat test was conducted on well R-2 to determine whether the site bedrock wells were providing an artificial conduit for contaminated shallow aquifer groundwater to migrate to the underlying productive sandstone bedrock unit.

2.2.3 Falling Head/Casing Seal Test Results

A falling head casing seal test was conducted on well R-2 by inflating the top packer 2 ft below the bottom of the casing and sealing off a 2-ft section of open borehole from the rest of the open borehole section of the well. The 2-ft bedrock interval that was left open below the casing consisted of low-permeability shale. The well casing was filled to the surface with potable water, and the change in water level in the well was monitored using electronic pressure transducers. If there were a proper casing seal in place, the water level in the well would have remained relatively constant; however, after the casing was filled to the surface, the water level quickly dropped back to static conditions. The water recharged much more rapidly than would be expected considering the low permeability of the exposed 2-ft-thick shale interval. The hydraulic conductivity was calculated from the falling head data to be 6.29 ft/day using the Bouwer and Rice falling head test method (Bouwer and Rice, 1976). This value is within the range for an unconsolidated sand material (Freeze and Cherry, 1979) and several orders of magnitude higher than would be expected for the 2-ft shale interval that was isolated during the test. This implies that the water leaked around the casing seal and into the annular space and the more permeable overburden material overlying bedrock. This evidence points to the lack of a proper casing seal in the annular space and suggests that the R-wells (R-1 through R-4) may not have been grouted or sealed by the driller at the time of installation.

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SECTION 3

INTERIM REMEDIAL MEASURES ACTIVITIES

3.1 OVERVIEW

The on-site bedrock wells requiring rehabilitation of the casing seals include production/recovery wells W-1 and W-10, out-of-service production well W-2, and monitor wells R-1, R-2, and R-3. All of these wells are located close to previously identified source areas on-site and have been shown to contain elevated levels of VOC. A summary of the reported well and casing depths and diameters, open borehole intervals and diameters, and approximate well yields are provided for each well in Table 3-1.

Results of packer testing, geophysical logging and review of historical well records suggest that these wells have leaking annular seals and/or deteriorated steel casing as a result of age or lack of casing grout (the W-wells are all more than 40 years old). Because of the presence of VOC in the shallow aquifer groundwater and soils, concern exists that these wells may be providing vertical migration pathways for contamination to the bedrock aquifer beneath the site. The sequential scope of work for the rehabilitation of these on-site wells is summarized as follows:

1. Remove recovery well pumps from the W-wells and the dedicated pumps from the R-wells and perform borehole geophysical logging in wells W-1, W-10, W-2, and R-3. Borehole geophysical logs were previously run in wells R-1 and R-2 as part of the packer testing program conducted in 1991.

2. Install and grout 8-inch-diameter casing liners in the W-wells and reinstall the recovery well pumps in wells W-1 and W-10. Following the required curing period for the liner grouts, the recovery wells would be restarted and brought back on-line.

3. Retrofit the R-wells as 2-inch-diameter, stainless-steel monitor wells designed to monitor the productive sandstone bedrock unit in each well. Following the required curing time for the grout, each well would be developed and the new smaller diameter, dedicated pumps installed.

Table 3-1

Well Construction Summaries of Bedrock Wells
To Be Rehabilitated During IRM Activities
EKCO Housewares, Massillon, Ohio

Well No.	Casing Depth (ft BGS)	Casing Diameter (inches)	Casing Type	Open Hole Total Depth (ft)	Open Hole Diameter (inches)	Yield (gpm)	Date Well Installed
W-1	28 total used ~27	12	Steel with drive shoe	225	12	125 (initial) 500 (post-TNT) Drilled: Apr. 1951	4/51
W-10	~25-30 (estimated)	12	Steel	~225	12	~125 (initial) ~500 (post-TNT)	Prior to 1943
W-2	90.6	12	Steel with drive shoe	231	12	~500 (estimated)	1/53
R-1	42	6.5	Steel	167	6	25 (estimated)	10/84
R-2	46	6.5	Steel	153	6	25 (estimated)	10/84
R-3	37	6.5	Steel	175	6	25-30 (estimated)	10/84

Notes: TNT - Indicates well was dynamited to increase yield upon completion.
BGS - Below ground surface.
GPM - Gallons per minute.

4. Monitor water levels in all water-bearing zones weekly for a period of approximately 1 month following start-up of the recovery well pumps. An assessment of the effects of the well rehabilitation activities on the capture zone that is maintained by the existing recovery wells would be made to determine the need for additional groundwater recovery wells.

Shallow well D-4-30 (estimated TD; 20 ft) was installed in 1987 as part of the Phase II soil boring program conducted by Floyd Brown Associates (FBA). The well was completed in low-permeability, fine-grained sediments as a 1½-inch (I.D.) PVC well to evaluate hydraulic conditions around the lagoon for RCRA compliance monitoring purposes. None of the four D-wells installed during this effort was considered to be an adequate long-term compliance monitoring point because of their small diameters and poor development (each well contains large amounts of sediment). The newer lagoon wells (L-wells) currently serve as replacements for the D-wells, all of which, save D-4-30, have since been abandoned. Well D-4-30 had been retained because of its strategic location on-site (WESTON, 1988).

Well D-4-30 is no longer used for water-level measurements and because of the poor condition of both the wellhead seal and well riser, the well should now be abandoned. The abandonment of well D-4-30 will involve the overdrilling of the well with 4¼-inch-diameter hollow-stem augers to TD. Once all well materials and cuttings have been removed from the overdrilling, the borehole will be tremie-grouted from the base of the borehole to ground surface using a 4% cement/bentonite slurry in accordance with ODNR regulations (ODNR, 1992).

3.2 IRM PROCEDURES

3.2.1 Borehole Geophysical Logging

A suite of borehole geophysical logs will be run in the W-wells and in well R-3 to determine the precise depth, diameter, and condition of each well casing. In addition, the depth to each of the bedrock stratigraphic lithologies (e.g., sandstones and shales) needs to be refined so that the formation packers in the W-wells can be set across shale beds and the screen and sandpack in well R-3 straddles the productive sandstone target. The suite of borehole geophysical logs to be run is as follows:

- **Caliper Log** — A three-arm caliper log will be run to provide a continuous record of the average diameter of the open borehole and casing. The closed tool will first be run to the bottom of the hole to determine the total depth of the well. The tool will then be opened and the mechanical arms maintained against the borehole wall by springs that allow the arms to open and close with changes in borehole size as the tool moves up the hole at a constant logging speed. All geophysical logs will be referenced to the top of the respective well casings.

- **Natural Gamma Log** — The gamma log provides a continuous record of the amount of natural gamma radiation emitted by the formations penetrated by a borehole. In general, the gamma activity of clay-bearing sediments and rocks (e.g., clays and shales) is much higher than that of quartz sands or sandstones. Naturally occurring gamma-emitting radioisotopes, such as potassium-40 and daughter products of the uranium and thorium decay series, are generally concentrated in clay. The gamma ray probe detects gamma radiation through the use of a passive sodium iodide crystal and scintillation counter. The greater the counting rate, the more events the gamma detector is measuring, which, in turn, corresponds to a higher clay content of the surrounding strata. The gamma tool will be run to the bottom of the borehole and recorded at a constant logging speed from the bottom to the top of the well.

- **Resistivity Log** — The resistivity log measures the electrical resistance (in ohms) of the earth materials lying within the well between two electrodes on the probe. Increases in formation resistance produce corresponding increases in resistivity on the log. In general, the resistivity log response in resistive rocks (sandstones) and conductive rocks (shales) provides a mirror image of the gamma log under suitable conditions. Because a constant electric current is generated between the two electrodes on the resistivity tool, the log requires a borehole fluid to conduct the current. As a result, the resistivity tool will be run from the bottom to the top of the fluid column in each well at a constant logging speed in each well. Repeat logs will be run in each well as a quality control check on whether electrical interference is occurring as the result of extraneous or man-made sources.

Interpretation of the borehole geophysical logs will be performed on-site to determine the final casing liner depths, screen depths, and sandpack intervals. Hard copies of all logs will be retained for final reporting purposes. Prior to the use of borehole geophysical in each well, all logging tools will be decontaminated using an Alconox detergent scrub, steam cleaning, and a potable water rinse.

3.2.2 Casing Liner Installations — W-Wells

The rehabilitation approach for the W-wells on-site involves the installation of 8-inch-diameter casing liners in each well. Wells W-1 and W-10 are currently used for production and groundwater recovery purposes, while well W-2 is an out-of-service former production well. Well W-2 will be retained for groundwater quality and performance monitoring of the bedrock aquifer in the southeast portion of the site.

Installation of the liners in the wells would involve the setting of an 8-inch polyvinyl chloride (PVC) casing to a depth approximately 10 ft beyond the depth of the existing well casing in each well. The precise depth of the casing liner would coincide with a low-permeability shale bed as determined from the results of the geophysical logging. Shale traps or formation packers would be attached to the end of each liner and two centralizers attached at evenly spaced intervals along the casing length. The annular space between the existing 12-inch casing and 8-inch liner would be tremie-grouted to ground surface with a 4% cement/bentonite slurry. After a minimum curing period of 24 hours, the recovery well pumps would be reinstalled and brought back on-line. An estimate of the time each recovery well will be out of service for rehabilitation is 2 days. A schematic representation of an estimated liner configuration for well W-1 is shown in Figure 3-1 to illustrate the type of work to be accomplished.

3.2.3 Rehabilitation — R-Wells

The rehabilitation approach for the R-wells is to retrofit or convert each of the wells from 6-inch-diameter open bedrock wells, to 2-inch-diameter screened bedrock wells. Currently these wells are used for quarterly groundwater monitoring. Each well would be screened from approximately 115 to 125 ft below ground surface (BGS) and sandpacked to approximately 10 ft above the top of the screen. A bentonite seal would be emplaced above the sandpack and a cement/bentonite slurry tremie-grouted from the top of the bentonite seal to ground surface. The thick cement/bentonite seal across the argillaceous sandstones

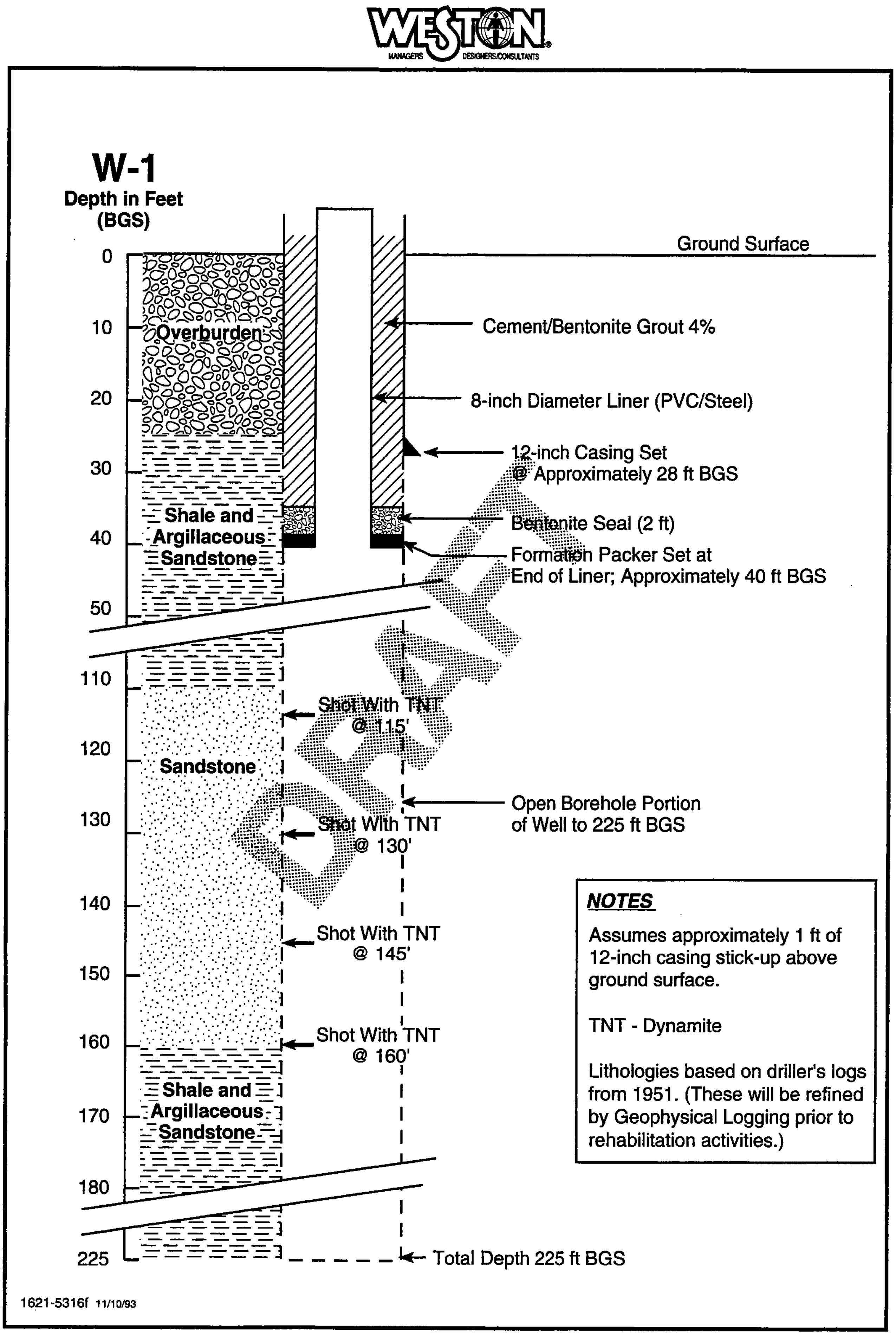


FIGURE 3-1 SCHEMATIC OF PROPOSED LINER INSTALLATION FOR WELL W-1, EKCO HOUSEWARES, MASSILLON, OHIO

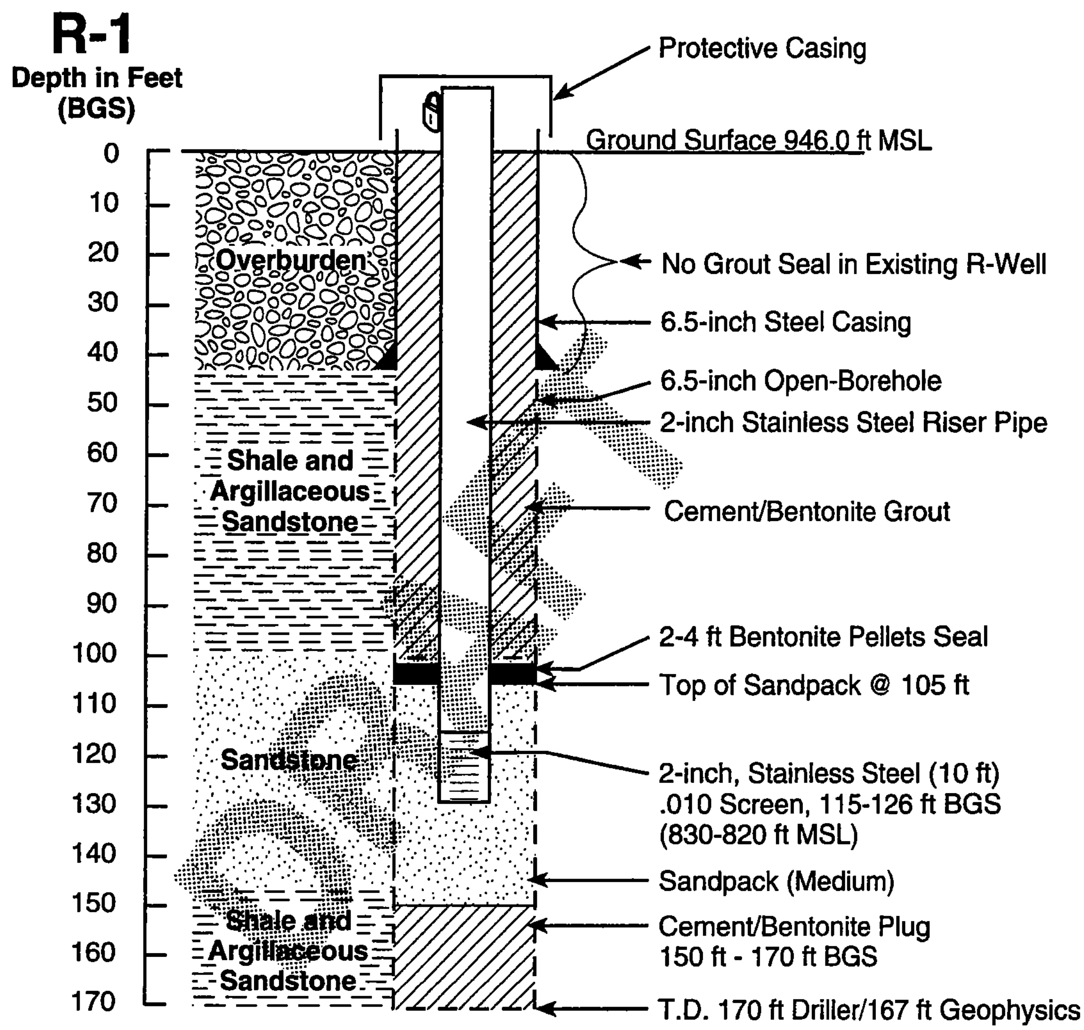
and shales would effectively isolate the productive sandstone unit from the more heavily affected overburden unit above. The grout across the casing seat would also fill and seal the annular space behind the existing 6-inch casing, thereby preventing the downward migration of shallow aquifer groundwater. After a minimum curing period of 24 hours, each monitor well would be developed using a submersible pump and bailing techniques. Schematic representations of the proposed conversions of wells R-1 through R-3, respectively, are shown in Figures 3-2 through 3-4.

3.3 POSTREHABILITATION MONITORING AND REPORTING

3.3.1 Water-Level Monitoring

Groundwater in the shallow, intermediate, and bedrock water-bearing zones at the EKCO facility is currently being remediated by pumping the bedrock production/recovery wells W-1 and W-10. The containment of the shallow and intermediate zones is apparently a result, in part, of leakage caused by improper sealing of the R-wells that were installed in 1984 and 1985 (R-1 through R-4). While implementation of the proposed well rehabilitation IRM will reduce the vertical migration of contaminated groundwater from the shallow water bearing zones, it may also reduce the hydraulic control currently exercised over the shallow water-bearing zones by pumping the bedrock recovery wells.

After the IRM is implemented, static water levels will be collected from wells completed in all water-bearing zones to assess the adjusted extent of hydraulic control resulting from rehabilitating the wells. Water levels will be collected weekly from all existing monitoring wells for a period of 1 month, following the restart of recovery wells pumpage. The locations of these monitoring wells are shown in Figure 2-2. Groundwater contour maps will be prepared for each water-bearing zone using the water-level elevations collected during this 1-month period. The resulting groundwater gradients and flow patterns will be evaluated for each water-bearing zone to assess what effects, if any, the IRM activities had on the hydraulic control at the site.



WELL STATISTICS

Casing Stickup: 0.9 ft
Drilling Method: Rotary
Date Drilled: 25 October 1984
6.5-in Casing set @ 42 ft BGS
Top of Bedrock @ 41 ft BGS

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FIGURE 3-2 SCHEMATIC OF PROPOSED CONVERSION FOR WELL R-1, EKCO HOUSEWARES, MASSILLON, OHIO

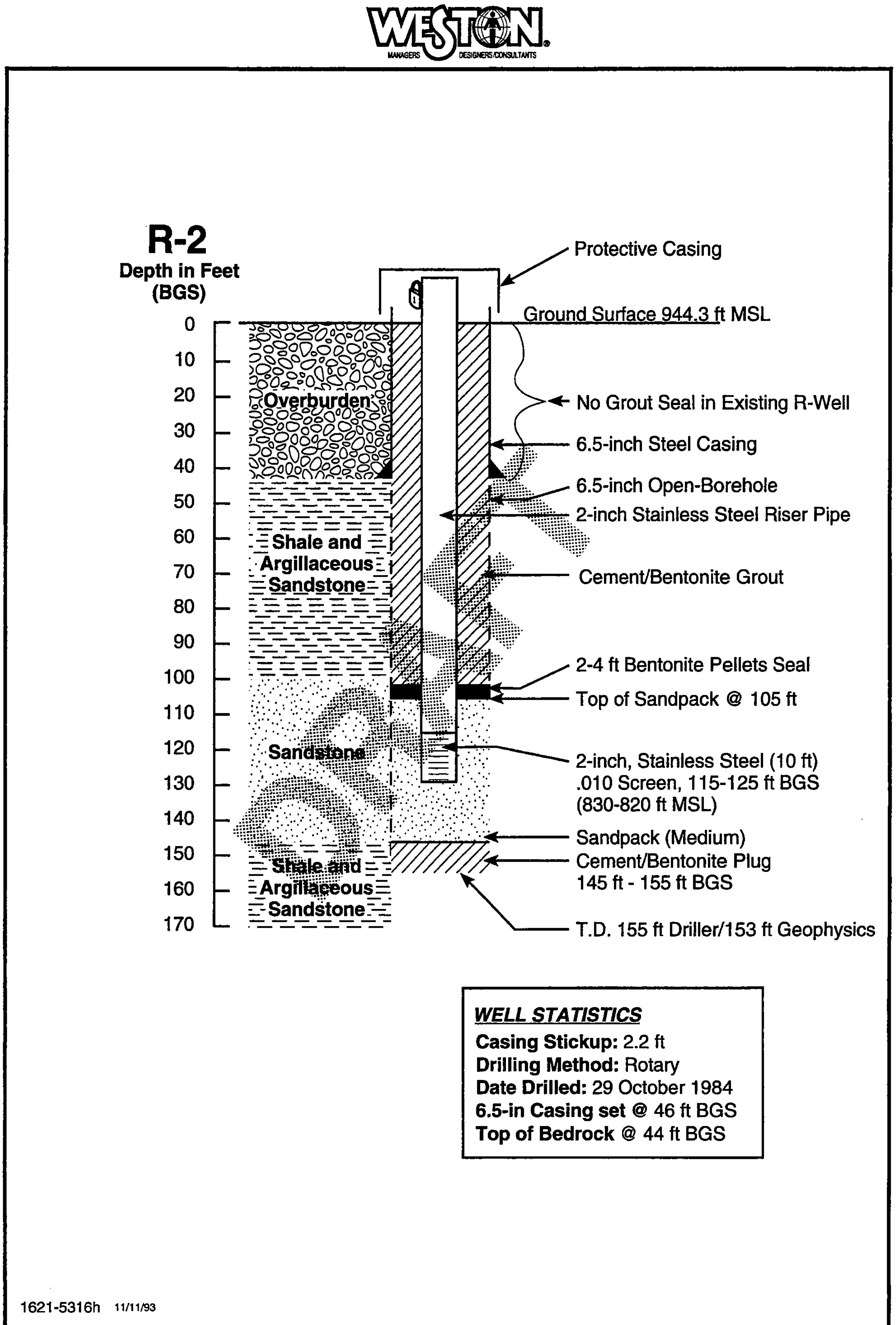
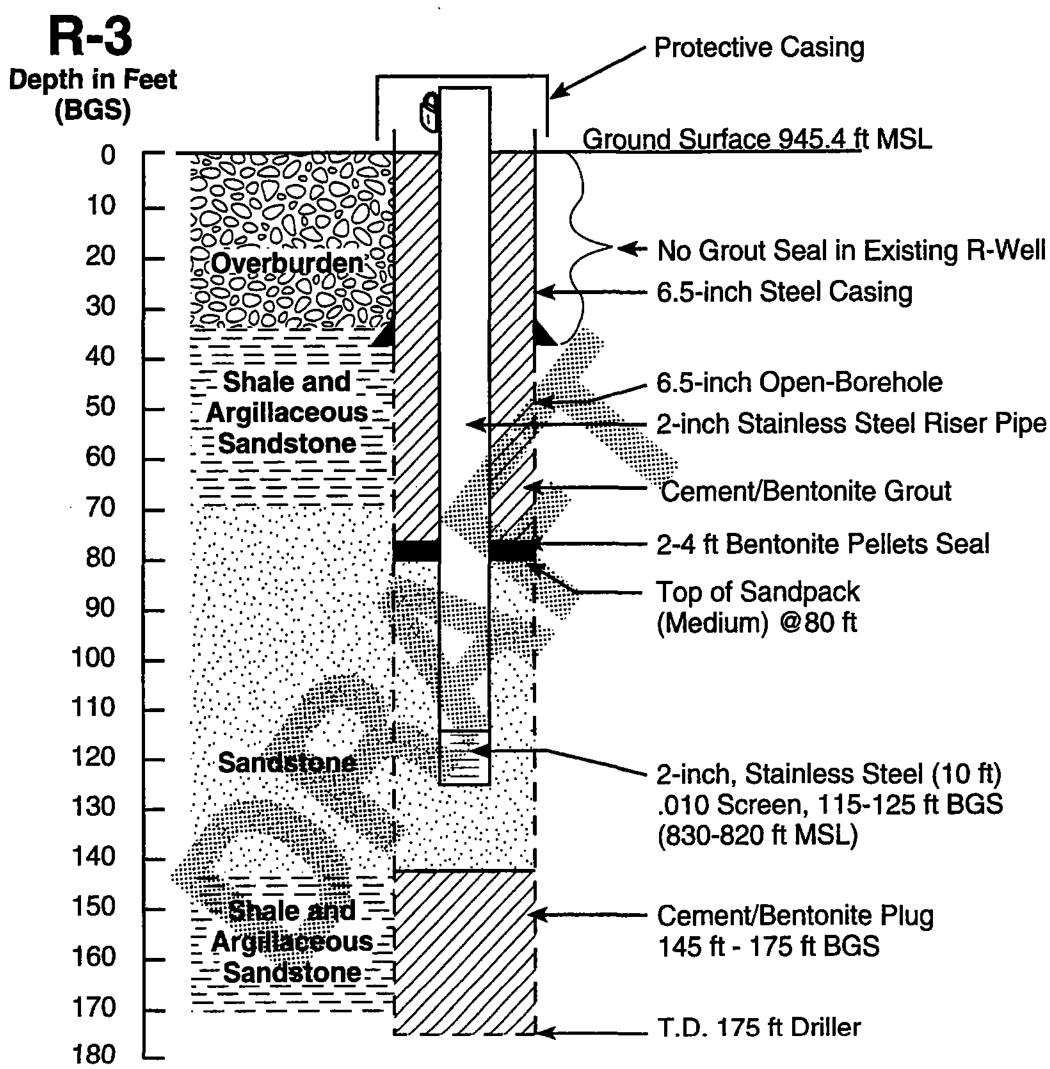


FIGURE 3-3 SCHEMATIC OF PROPOSED CONVERSION FOR WELL R-2, EKCO HOUSEWARES, MASSILLON, OHIO



WELL STATISTICS

Casing Stickup: 1.74 ft
Drilling Method: Rotary
Date Drilled: 30 October 1984
6.5-in Casing Set @ 37 ft BGS
Top of Bedrock @ 32 ft BGS

1621-5316i

FIGURE 3-4 SCHEMATIC OF PROPOSED CONVERSION FOR WELL R-3, EKCO HOUSEWARES, MASSILLON, OHIO

3.3.2 <u>Reporting</u>

Following completion of the IRM activities, an IRM report will be submitted to EPA Region V and will include the results of abandonment of well D-4-30, the geophysical logging, liner installations in the W-wells, rehabilitation of the R-wells, and postrehabilitation groundwater monitoring in the monitoring wells. Included in the reports will be geophysical logs, well construction diagrams, groundwater contour maps of the postrehabilitation monitoring, and text describing the procedures, results, and recommendations for any further corrective actions, if needed.

SECTION 4

SCHEDULE

The schedule for implementation of the IRM activities is contingent on approval from EPA Region V. From the date of Agency approval, mobilization to the site would be affected within 2 weeks. This time would be required for obtaining the appropriate well materials and for notifying the subcontractors who will be providing the geophysical logging services and pump hoist rig. The estimated duration of the actual IRM activities (well rehabilitations only) is 11 days. Assuming 1 month of postrehabilitation monitoring, the IRM report would be submitted 2½ months after receiving EPA approval.

SECTION 5

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Received 6/13/94

DRAFT REPORT
INTERIM REMEDIAL MEASURES
EKCO HOUSEWARES FACILITY
MASSILLON, OHIO

DRAFT

June 1994

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Work Order No. 02994-002-005-0010-60

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SECTION 1

INTRODUCTION

This report contains the results of the Interim Remedial Measures (IRM) activities conducted at the EKCO Housewares, Inc. (EKCO) facility in Massillon, Ohio, from 21 March through 29 April 1994. This work was performed pursuant to the Draft IRM Work Plan which was submitted to the U.S. Environmental Protection Agency (EPA) Region V, on behalf of American Home Products Corporation (AHPC) in December 1993 and approved by EPA Region V in February 1994.

AHPC retained Roy F. Weston, Inc. (WESTON) in 1990 to conduct a Resource Conservation and Recovery Act (RCRA) Facility Investigation and a Corrective Measures Study (RFI/CMS) for the EKCO facility. The RFI portion of the RFI/CMS was conducted from April 1991 through March 1992. The Final RFI and Draft CMS reports were submitted to the EPA in August and September 1993 respectively. The RFI and Draft CMS reports were each approved, with modifications, by EPA on 3 November and 21 October 1993 respectively. The IRM activities included in this report have been previously discussed in both the RFI and CMS reports, as well as in a May 1992 correspondance and an April 1993 meeting, both between AHPC/WESTON and EPA Region V. The IRM activities conducted at the site were as follows:

- Rehabilitation of six (6) on-site bedrock wells by properly sealing the well casings against confining layers present in the side walls of the boreholes. This rehabilitation work was designed to eliminate interaquifer communication and contaminant migration between the shallow overburden aquifer and the bedrock aquifer beneath the site. The on-site bedrock wells requiring rehabilitation included production/recovery wells W-1 and W-10, out-of-service production well W-2, and monitor wells R-1, R-2 and R-3.

- Abandonment of shallow overburden monitor well D-4-30 by overdrilling and grouting the borehole in accordance with the Ohio Department of Natural Resources (ODNR) regulations for well abandonment. Because of the siltation problems associated with the poor condition of the wellhead seal and casing riser, the agency agreed with the need for abandonment of this well.

- Following completion of rehabilitation activities, monitoring of the groundwater levels in all aquifer units was performed to assess the extent to which the pumping of the site recovery wells continue to affect the aquifer gradients and capture zones.

As part of a packer testing program conducted during the RFI in April 1991, a casing seat test was performed on well R-2. The results of this test indicated that the casing seat was leaking and allowing shallow aquifer groundwater to enter the well and migrate downward into the open borehole section of the well. Additionally, the packer testing results in the open borehole portions of wells R-1, R-2 and R-4 indicated that a downward hydraulic gradient existed in each of these wells, a finding consistent with the site wide bedrock geology. The problems associated with leaking or deteriorated bedrock well casings are as follows:

- The leaking casing seats provide conduits for groundwater to migrate from the overburden water-bearing units, which currently contains approximately 3 mg/L of VOCs, to the bedrock water-bearing unit, which historically contains approximately 1 mg/L of VOCs. The bedrock wells which were rehabilitated were all located in close proximity to the on-site VOC source areas identified during either the RFI or previous investigations.

- The mixing of the overburden and bedrock groundwater at the leaking wells could potentially extend the time required for cleanup of the bedrock aquifer and cause analytical groundwater sampling data for the bedrock unit to be nonrepresentative of in-situ conditions.

- The artificial hydraulic connection between the overburden and the bedrock could cause innacuracies in water-level measurements to occur in both water-bearing zones.

Two shallow aquifer groundwater recovery alternatives are described in the Draft CMS report (WESTON, 1993), which address the potential for the reduction of hydraulic control in the shallow aquifer due to the rehabilitation of the well casings. The results of the IRM activities will be considered by the EPA during the selection of the final Corrective Measure Alternative(s) for the site. Supplemental supporting documents to this IRM report include:

1. WESTON. December 1993. *Draft Final Interim Remedial Measures Work Plan, EKCO Housewares Facility, Massillon, Ohio.* Prepared for EPA, Region V.

2. WESTON. November 1993. *Final Corrective Measures Study, EKCO Housewares, Inc., Massillon, Ohio.* Prepared for EPA Region V.

3. WESTON. August 1993. *Final RCRA Facility Investigation Report for EKCO Housewares, Inc., Massillon, Ohio* Prepared for EPA Region V.

1.1 SITE BACKGROUND

1.1.1 Site Location

The EKCO Housewares facility occupies approximately 13 acres in the town of Massillon, Stark County, Ohio (Figure 1-1). The area surrounding the site is largely urban and industrial. Land use to the northwest is more rural with a larger proportion of open space. The EKCO property is triangular in shape and lies an estimated 1,500 ft west of the Tuscarawas River (Figure 1-2). The facility is bordered to the north by Newman Creek, while Conrail and the Baltimore and Ohio railroads border the EKCO property to the west and east, respectively.

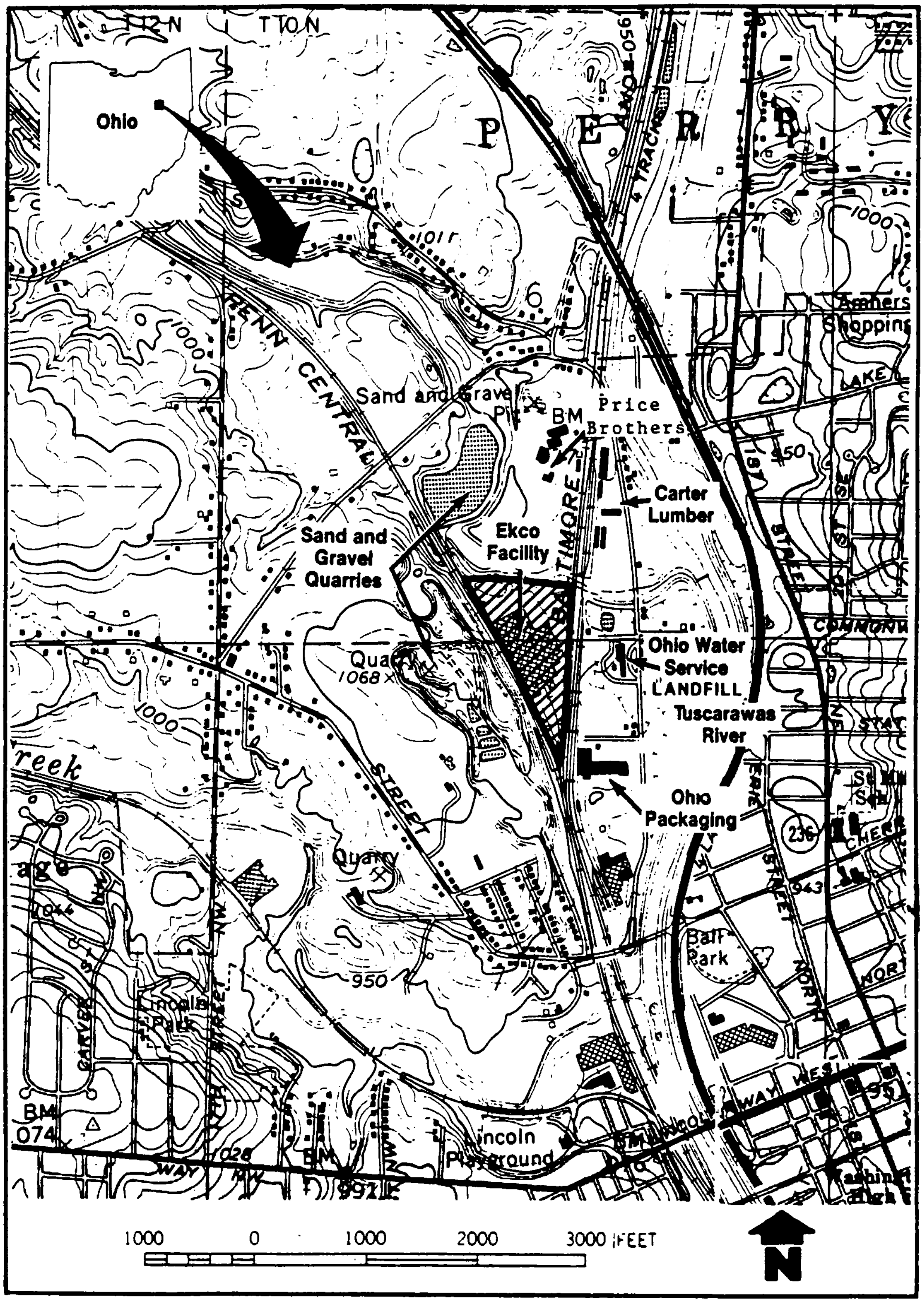

FIGURE 1-1 SITE LOCATION MAP
EKCO HOUSEWARES, INC., MASSILLON, OHIO
(Ref. 7.5 Minute Massillon Quad, Ohio, 1978)

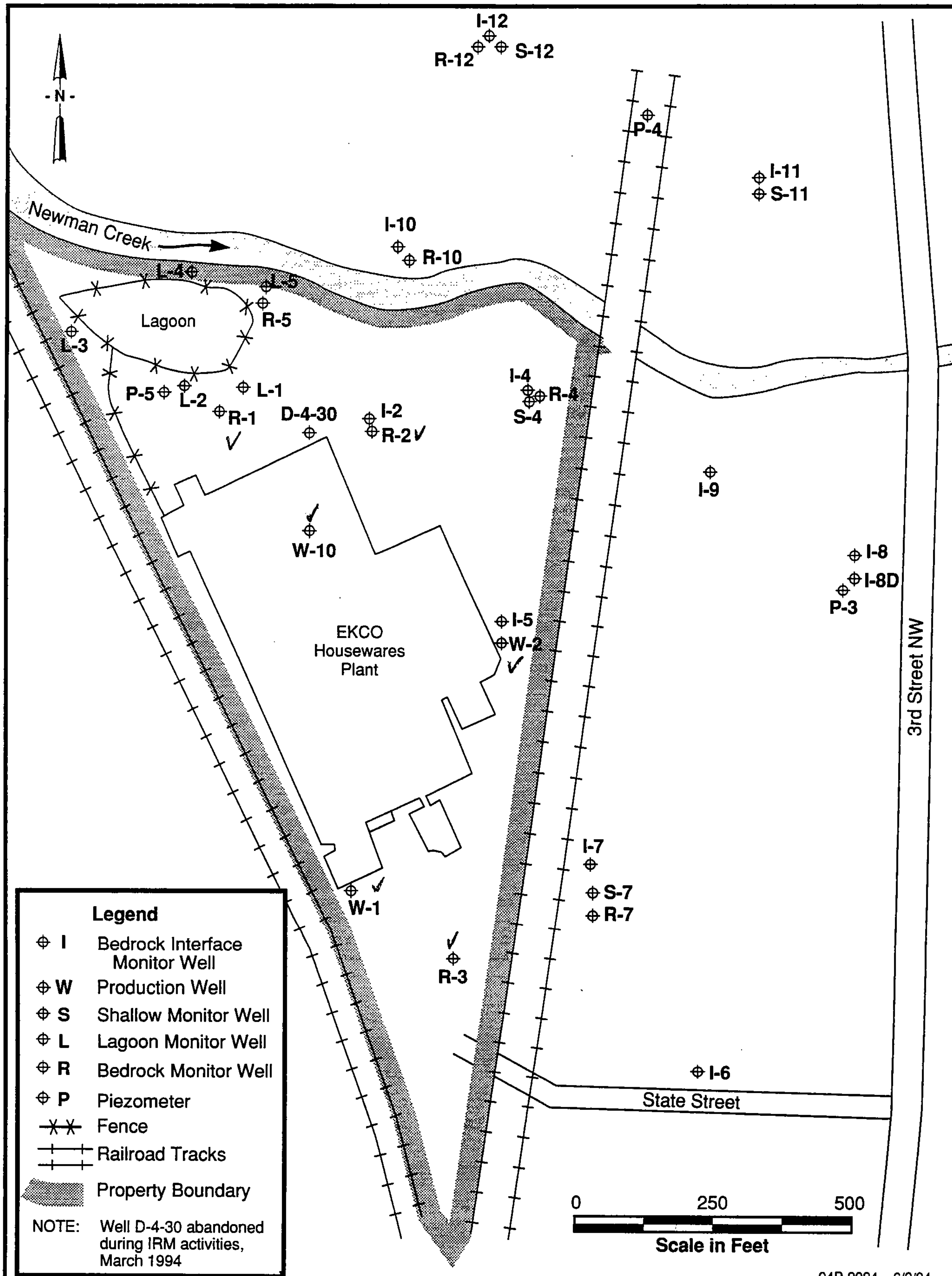

FIGURE 1-2 SITE PLAN
EKCO HOUSEWARES FACILITY
MASSILLON, OHIO

1.1.2 Site History

A summary of the EKCO site history is presented in Table 1-1. During 1954, EKCO began coating cookware manufactured at the facility. Solvents, primarily trichloroethylene (TCE) or 1,1,1-trichlorethane (1,1,1-TCA), were used to clean the products prior to coating. Sometime during the mid 1960s, EKCO stopped using TCE; however, the use of TCE was reinitiated in the 1980s. The current operation consist of the manufacture of pressed and coated non-stick bakeware. A silicon-based compound is presently used to coat the bakeware to create the non-stick surface.

Correspondence between EKCO and the Ohio Environmental Protection Agency (OEPA) identified a solvent spill that occurred between 1979 and 1980 as the first major recorded spill at the facility. The spill was reported to have occurred in the vicinity of plant production well W-10, (Figure 1-3), but the extent of the spill was not documented.

In March 1984, when the plant applied for a renewal of its National Pollution Discharge Elimination System (NPDES) permit, an analysis of on-site well water for volatile organic compounds (VOCs) was required. The analysis indicated the presence of 1,1,1-TCA and TCE in the groundwater beneath the site. As a result of this discovery in 1984, EKCO initiated a number of activities to investigate the problem, which culminated with the 1993 RFI and, ultimately, the CMS in September 1993.

In 1992, EKCO reported to the U.S. EPA Region V, a 330-gallon spill of 1,1,1-TCA on the western side of the building (Figure 1-3). Some TCA entered a nearby storm sewer and reached the outfall at Newman Creek. TCA was recovered from the storm sewer using a vacuum truck. The portion of the sewer where the spill entered was blocked, and an underwater weir was constructed at the sewer outfall and an activated carbon filter was placed on the upstream side of the weir to adsorb product. Fifty tons of soil were excavated from the spill location in the presence of an OEPA representative. The soil was containerized and transported to the Envirosafe Services of Ohio, Inc. hazardous waste landfill in Toledo, Ohio.

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Table 1-1

EKCO Facility History

Date	EKCO Site History
Ca 1929-32	First recorded activities at facility. Property is owned by Standard Oil Company.
Ca 1929-42	Fort Pitt/Massillon Bridge Works - Manufacture of iron and steel bridges and structural iron.
1945	Manufacturing Aluminum and stainless steel cookware.
1950	Production wells W-1 and W-2 were installed and put into service to produce water for plant activities. Well W-1 has been used continuously since then, and well W-2 was used until it was taken out of service in the late 1970s.
1951	The plant began with the U.S. involvement in the Korean conflict manufacturing 90-mm and 105-mm shell casings for the military. This increase in production necessitates the drilling of two production wells (W-1 and W-2).
1953	A surface impoundment was constructed along the northern property boundary adjacent to Newman Creek, Sludge frame waste treatment was discharged to it. Began copper-plating cookware, used primarily TCE or 1,1,1-TCA to clean cookware.
1964	Stopped using TCE; 1,1,1-TCA was used in its place.
1965	AHPC acquired EKCO Housewares.
1967	Installation of porcelain and teflon coating units.
1969	Surface impoundment meets newly formed NPDES regulations and permits.
March 1986	The air stripper system was installed and put into service.
July 1974	NPDES Permit No. C-3094BD was issued to EKCO.
1977	EKCO discontinued the manufacturing of aluminum and porcelain cookware and the use of the lagoon ceased.
1978	All copper plating operations ended; the principal manufactured products were pressed and coated nonstick bakeware.
1979-1980	The only major documented solvent spill to date at the facility was recorded; neither the exact location nor the extent of the spill was documented.
1980	The surface impoundments was reactivated under the existing NPDES permit and received housing alkaline degreaser filter water.
March 1984	In applying for a renewal of their NPDES permit, the plant was required to analyze on-site well water for VOCs, this analysis indicated the presence of 1,1,1-TCA and TCE.
June 1984	All discharges to lagoon ceased.
1984	AHPC sold EKCO Housewares to the EKCO Group.
May 1992	EKCO reported a 330-gallon 1,1,1-TCA spill to EPA. EKCO removed 50 tons of soil from the area of the solvent release.
Present	EKCO continues to manufacture pressed and coated nonstick bakeware. A silicon-based compound is presently used to coat the bakeware to create the nonstick surface.

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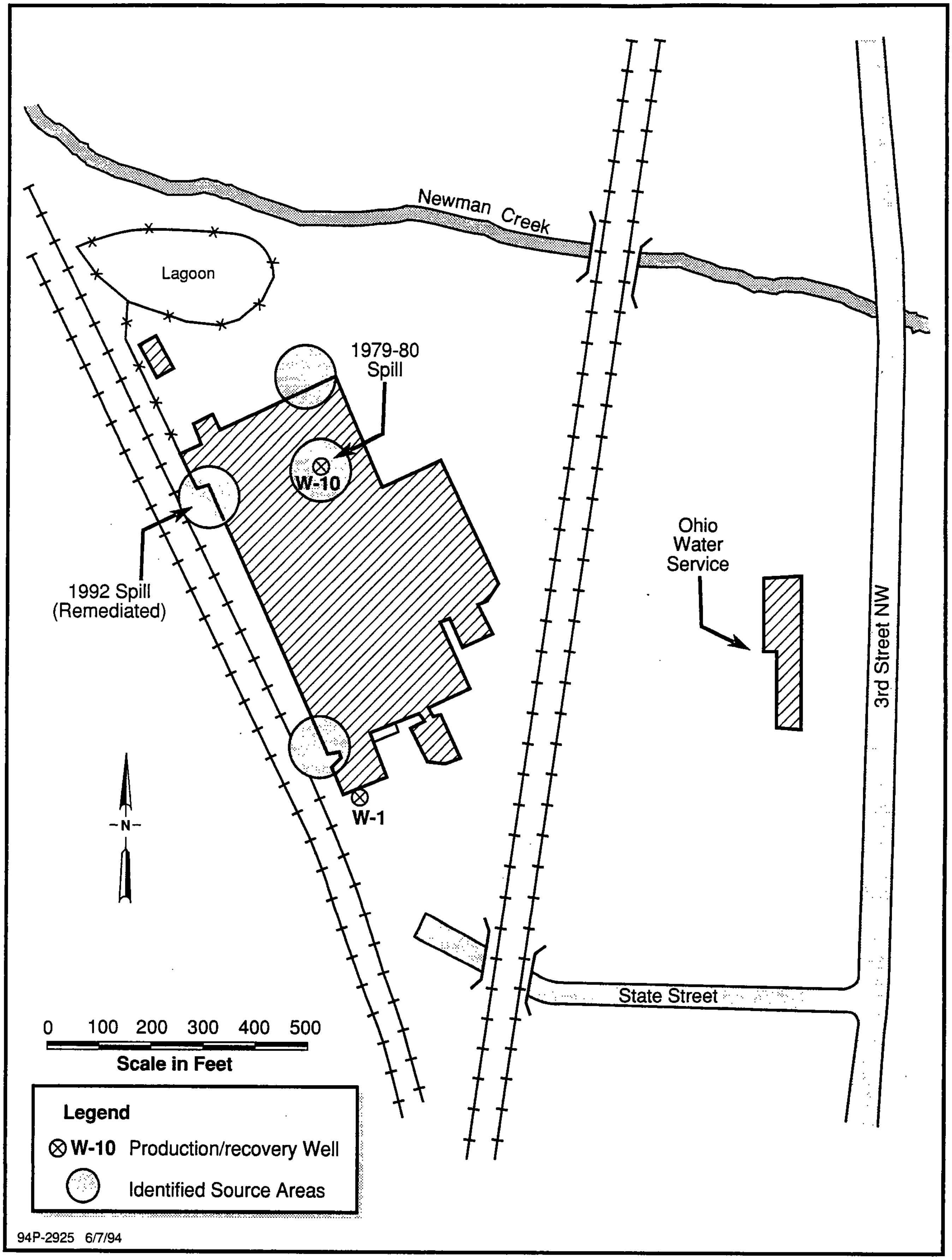


FIGURE 1-3 THE LOCATIONS OF DOCUMENTED SPILLS AND VOC SOURCE AREAS IDENTIFIED DURING THE RFI EKCO HOUSEWARES FACILITY – MASSILLON, OHIO

1.2 Environmental Setting

1.2.1 Site Topography

The majority of the EKCO facility is generally flat. The northern edge of the facility slopes steeply toward Newman Creek. Surface water runoff at the facility discharges to Newman Creek by two pathways: surface runoff on the northern part of the facility flows directly into Newman Creek, and surface discharge from the remainder of the facility is routed through the storm sewer system, which discharges into Newman Creek through Outfall No. 001 located just east of the Baltimore and Ohio Railroad tracks. A small northern portion of the facility is located within the 100-year floodplain of Newman Creek.

1.2.2 Site Geology

The EKCO facility is situated on the western flank of a glacial valley that extends to the north and south and was carved from Pennsylvanian age sedimentary rocks during the Pleistocene glaciation. The glacially deposited sediments form a thin veneer 15 to 30 ft thick in the western half of the site where the depth to bedrock is shallow. The sediments infill towards the glacial valley to the east, reaching a maximum on-site thickness of approximately 110 ft at the eastern property boundary. Further off-site to the east, these unconsolidated sediments reach thicknesses exceeding 252 ft. Based on the drilling of the on-site overburden monitor wells and soil borings, the glacial materials encountered in the western portion of the facility were identified as high permeability sand and gravel units seperated by low permeability silt and clay units.

Underlying the glacial sediments, bedrock is encountered at its highest elevation in the northwestern portion of the site and slopes to the east at an approximate 17° angle. The slope of the bedrock surface is interpreted as an erosional feature caused by the past glaciations which deposited the overburden materials. The bedding is nearly flat-lying and has undergone little if any folding or faulting. Bedrock encountered at the site consists of four interbedded layers. The shallowest bedrock unit encountered consists of an interbedded low permeability shale and argillaceous sandstone unit, which is underlain by a high permeability, well sorted sandstone. The sandstone unit is the primary bedrock water bearing unit at the site. Below the sandstone is another low permeability interbedded shale and argillaceous sandstone unit, which is directly underlain by shale.

The bedrock stratigraphy beneath the site was determined from the results of geophysical logging, packer testing, driller's logs and regional data from the U.S. Geological Survey (USGS). Figures 1-4 and 1-5 show generalized geologic cross-sections of the stratigraphic units beneath the site.

1.2.3 Site Hydrogeology

The permeable hydrostratigraphic units present in the western half of the site are the shallow sand and gravel, intermediate sand and gravel and the sandstone bedrock. These high permeability units are separated by low permeability clays and silts (in the overburden), or shale and argillaceous sandstone (in the bedrock). In general, the sand and gravel and the sandstone units act as the primary medium for groundwater flow and the low permeability silt, clay, shale and argillaceous sandstone act as barriers to vertical groundwater flow; however, variations in permeability occur locally. Just east of the site property boundary, a deep sand and gravel unit exists which thickens further to the east. In the vicinity of wells I-4 and R-4, (Figure 1-4), this deep sand and gravel unit is in direct contact with the major sandstone unit which yields a majority of the groundwater to the site production/recovery wells. A portion of the hydraulic gradient in the deep sand and gravel unit is influenced towards the site as a result of the recovery wells pumpage.

Results from the packer testing conducted in bedrock wells R-1 and R-2 demonstrated the confining capacity of the shale beds which overlie the productive sandstone unit in each of these wells. During the pumping phase of each test, the hydraulic heads above and below the packers (set across shale beds) did not change. In addition, the static water levels within the straddled zones were considerably higher than the bottom of the overlying shale beds

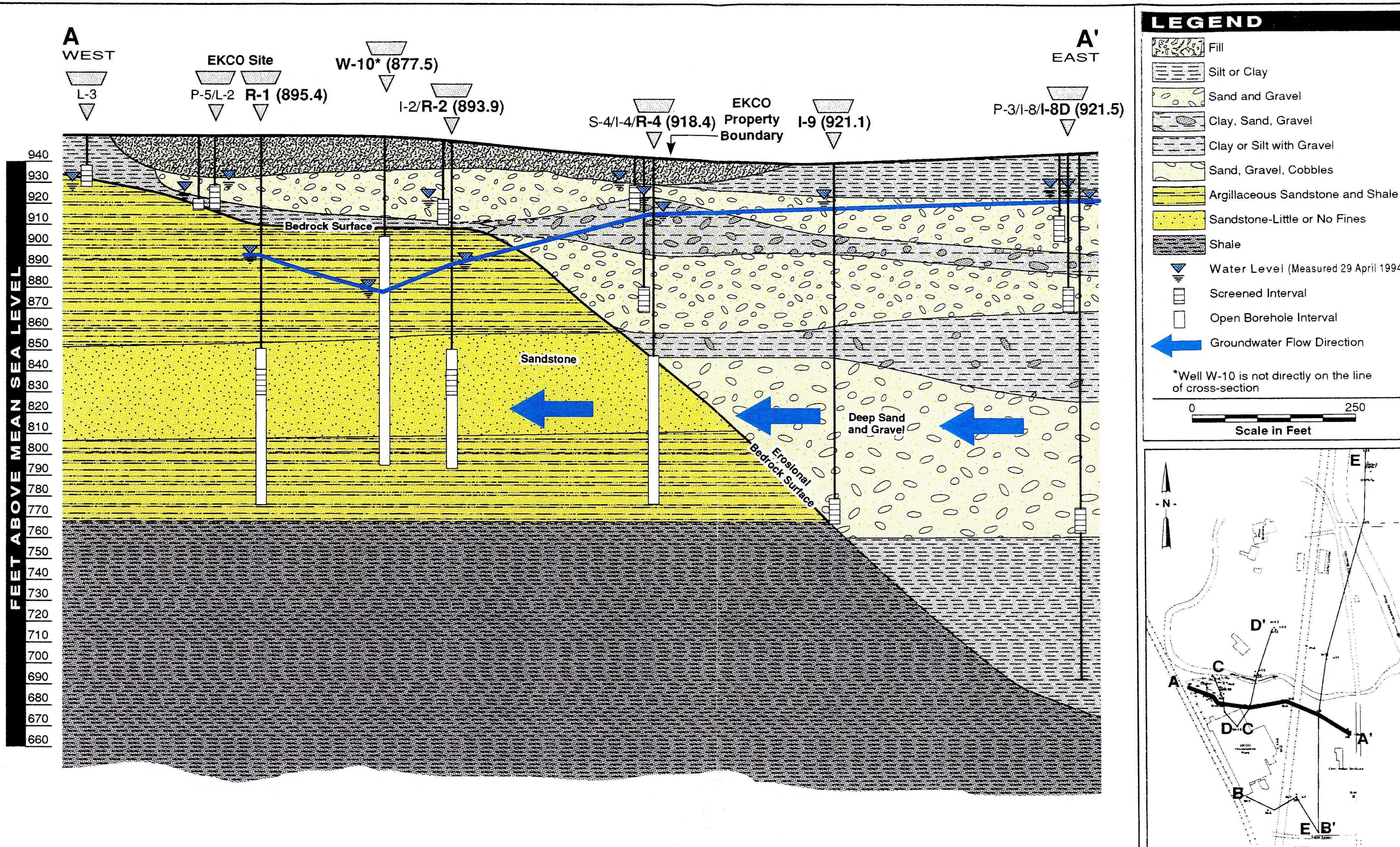


FIGURE 1-4
ANNOTATED GEOLOGIC
CROSS SECTION A-A'
AT THE EKCO HOUSEWARES PLANT,
MASSILLON, OHIO

94P-2928 6/7/94

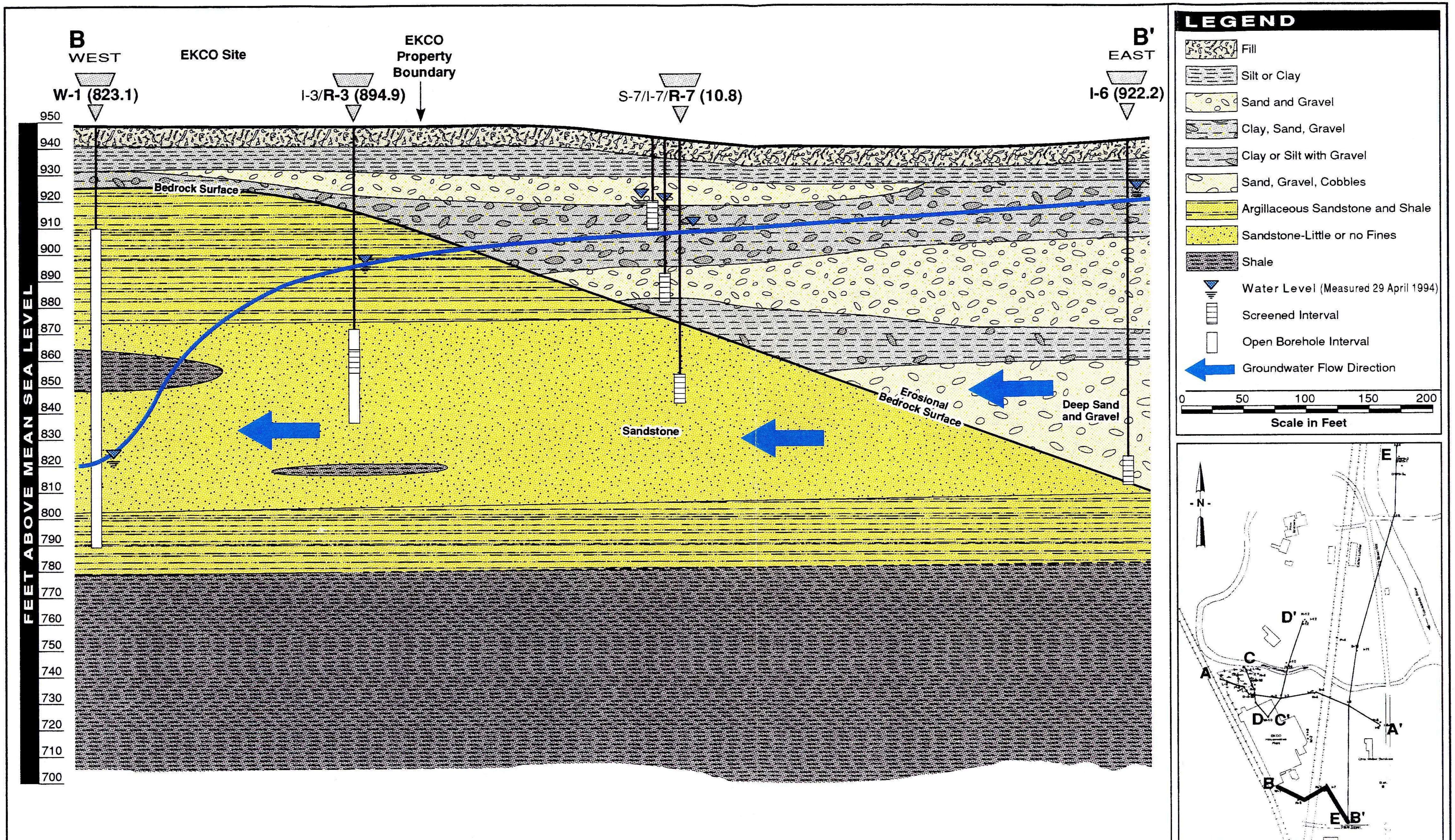


FIGURE 1-5
ANNOTATED GEOLOGIC
CROSS SECTION B-B'
AT THE EKCO HOUSEWARES PLANT,
MASSILLON, OHIO

94P-2927 6/9/94

for all five of the tested zones, indicating that the overlying shale units were causing the test intervals to be under semi-confined conditions. A comparison of the specific capacities obtained from the packer tests also serves to demonstrate the low permeability of the argillaceous sandstones. The productive sandstone in wells R-1 and R-2 provided measured specific capacities of 1.82 and 1.80 gallons per minute per foot (gpm/ft), whereas the argillaceous sandstones provided much lower measured specific capacities ranging from 0.0069 and 0.06 gpm/ft.

The 40 to 50 ft thick sequence of alternating shales and argillaceous sandstones that overlie the productive sandstone unit beneath the site would be expected to provide a natural barrier to vertical groundwater flow. However, the site recovery wells W-1 and W-10 appear to hydraulically control the groundwater flow directions in the shallow aquifer units on-site despite being open only to the bedrock water bearing units. In addition, elevated contaminant concentrations in the bedrock wells in the western half of the site appeared to indicate that the low permeability units overlying the productive sandstone may have been breached. As a consequence of these findings, a falling head/casing seat test was conducted on well R-2 to determine whether the site bedrock wells were providing an artificial conduit for contaminated shallow aquifer groundwater to migrate to the underlying productive sandstone bedrock unit.

1.3 NATURE AND EXTENT OF CONTAMINATION

1.3.1 Source Identification Summary

Based on soil borings advanced in 1988 and 1991, the following three VOC source areas were identified (see Figure 1-3):

- Tank area at southwestern end of plant.
- Sump at production well W-10.
- Tank area at northern end of plant.

TCE was the primary constituent detected at the tank area at the southwestern end of plant. TCE contamination was detected at concentrations of 140 ppm and 2 ppm in two of the borings drilled in this area. In the tank area at the northern end of the building, TCE and dichloroethene (DCE) were the primary constituents detected. TCE was detected at all depth intervals in borings installed at the northern end of the building. DCE was detected at 34 ppm in one boring installed through the floor of the building adjacent to the sump at well W-10.

1.3.2 Groundwater Geochemical Summary

Groundwater sampling was conducted at the EKCO site in December 1988, September 1991, and March 1992. The on-site and off-site monitoring wells and production wells at the EKCO facility are shown in Figure 1-6. In addition to these three sampling events, selected wells have been sampled quarterly since 1989 as part of the lagoon closure. Groundwater sampling has been conducted for both VOCs and metals.

The VOCs detected in the groundwater were predominantly TCE, 1,1,1-TCA, and their respective breakdown products. The results indicate that high concentrations of TCE and 1,1,1-TCA occur in the shallow groundwater near the source area north of the plant near well D-4-30, in the intermediate groundwater at Well I-2, and in the bedrock groundwater near wells W-10, R-1, and R-2. The percentage of breakdown products increases with increasing distance from the source areas at wells W-10 and D-4-30. Groundwater in the shallow, intermediate, and bedrock water bearing zones is staying on-site and flowing toward the production wells, W-1 and W-10. Any dissolved VOCs that exist in the groundwater at the site are being recovered by the site production wells and are being treated by the on-site air stripper system. A portion of the groundwater in the deep sand and gravel unit just east of the site flows back towards the facility as a result of the recovery wells pumpage. These findings suggest that the primary area of concern, with respect to groundwater contamination and inter-aquifer communication, is in the western half of the site where source areas in soils and elevated shallow aquifer contamination is present. The IRM activities were designed to correct the problems associated with the bedrock wells in these areas and to

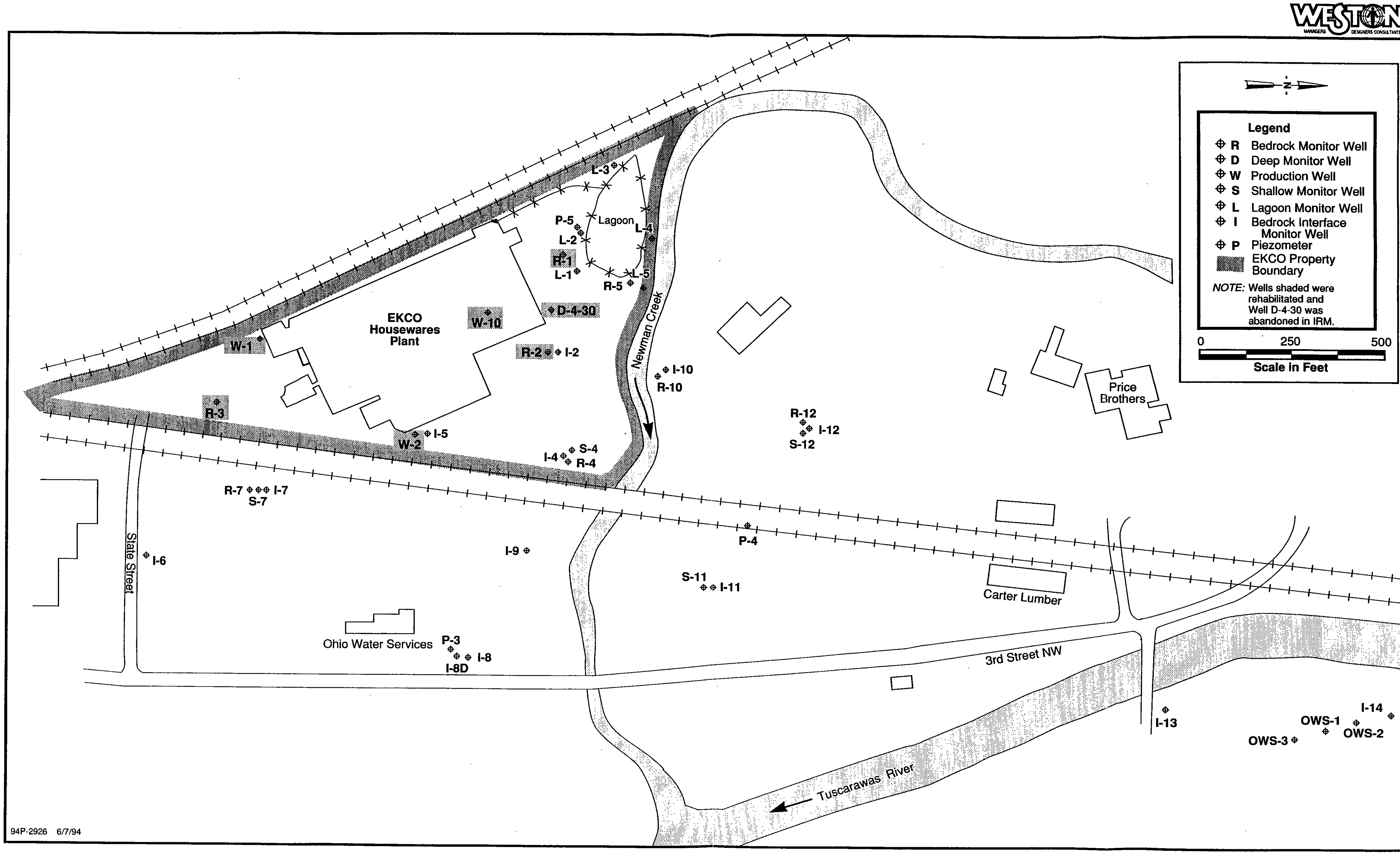


FIGURE 1-6 MONITOR WELL LOCATION MAP
EKCO HOUSEWARES FACILITY - MASSILLON, OHIO

prevent the spread of contamination from the shallow groundwater to the bedrock aquifer and deep sand and gravel aquifer east of the site.

1.4 Local Groundwater Usage

1.4.1 Ohio Water Service Municipal Wells

Currently, the Ohio Water Service Company (OWS) has seven active production wells (OWS-1, 2, 3, 5, 7, 8, and 9), and one well (OWS-4) that was taken off-line for municipal use and subsequently converted into an observation well. The OWS well field pumps approximately 7.5 million gallons per day (gpd) from the seven production wells. All of the OWS wells are reported to have been completed in the deep sand and gravel unit, constructed with 50-ft screens and reach total depths of 150 to 160 ft. The locations of the OWS wells are provided in Figure 1-7.

1.4.2 Private Wells

Approximately 50 domestic wells and three commercial wells are located within a 1-mile radius of the EKCO facility. No information is available on the depths or construction details of these domestic wells. The average depths of the three commercial wells is 225 ft. The location of these commercial wells is also shown in Figure 1-7.

1.4.3 EKCO Production/Recovery Wells

There are currently two on-site production wells W-1 and W-10 (Figure 1-3), being used as both recovery wells and as production wells for use in manufacturing processes at the facility. Groundwater from production wells W-1 and W-10 is treated in an on-site air stripper, then either routed to various plant processes or discharged to Newman Creek via an underground storm sewer. Well W-1 was reportedly completed as an open-hole well in bedrock to a total depth of 225 ft. Geophysical logging of W-1 during the IRM activities indicated that the well is currently open to 205 ft. At this location during drilling, shale

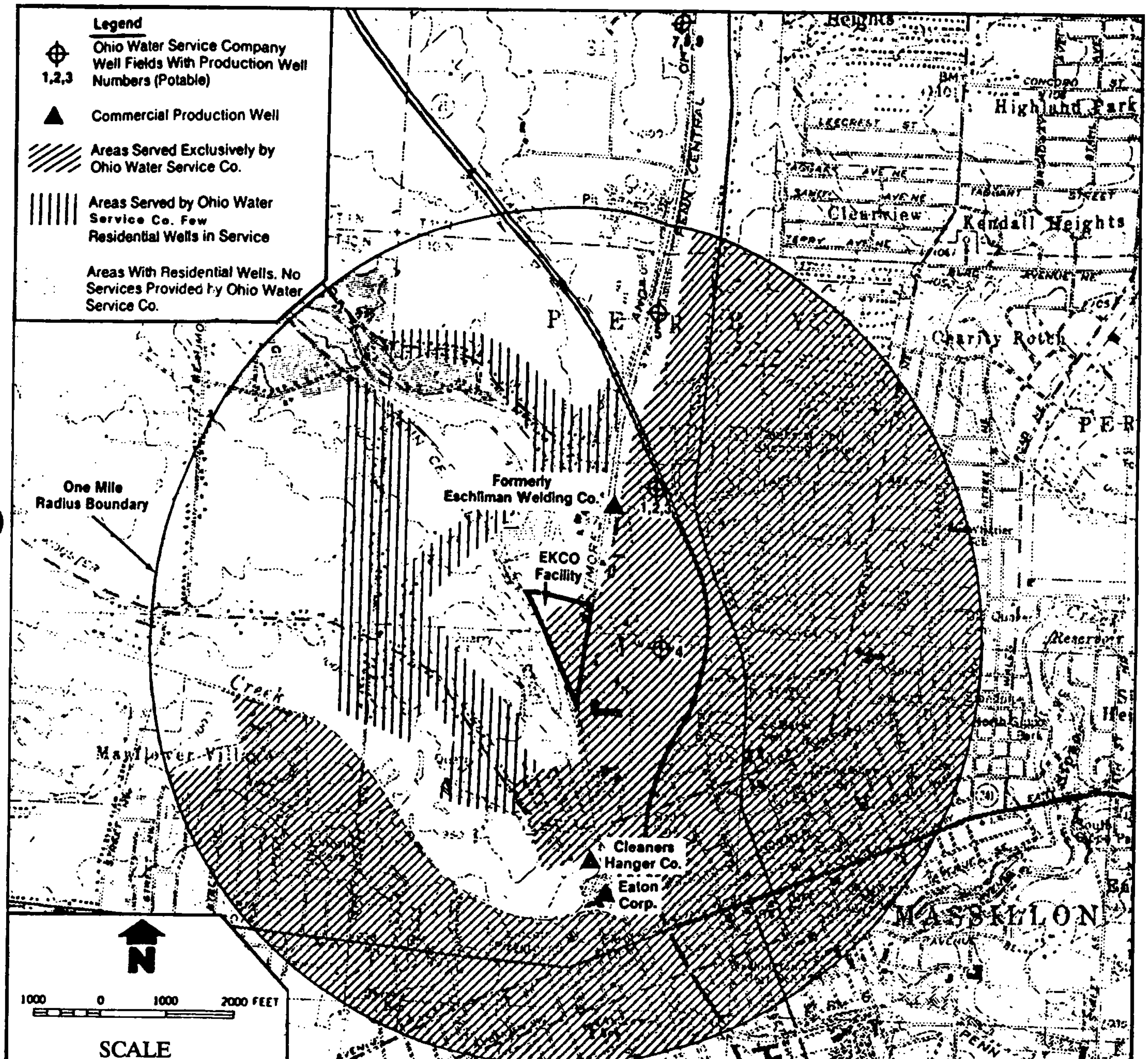


FIGURE 1-7 WATER SUPPLY MAP WITHIN ONE MILE RADIUS OF THE EKCO FACILITY BOUNDARY

bedrock was reportedly encountered at 25 ft, followed by a series of interbedded sandstones and shales. Construction details (driller's logs) for W-10 are unavailable at this time, but geophysical logging during the IRM activities indicated the well was cased to 44 ft and is currently open to a total depth of 159 ft. As with all of the bedrock wells on-site, production wells W-1 and W-10 produce the majority of their groundwater from the major sandstone unit which exists beneath the site between the elevations of aproximately 790 and 850 ft Mean Sea Level (MSL). This sandstone unit, while productive, was dynamited across its length in wells W-1, W-2 and W-10 to maximize the yield of these wells at the time of installation.

The pump-and-treat recovery system began in February 1986 with the concurrence of OEPA. When the system was instituted, W-1 pumped 240 gpm and W-10 pumped 140 gpm. Available records indicate that these pumping rates were fairly constant through the first 2 years of the pump and treat program. During this time, flow rates reportedly varied about 10 to 15 gpm. In 1988, the pumping rate of W-10 was increased to 255 gpm in April and continued to increase throughout the year to its December rate of 345 gpm. The pumping rate of W-1 remained constant during 1988 at 245 gpm.

Since the onset of the remedial pump-and-treat system at the site, VOC levels in recovered groundwater have shown a steady decline. Total VOC levels in the recovered groundwater were 18 mg/L in 1986. By 1987 total VOC levels had dropped to 8 mg/L. During 1990, 1991, and 1992, total VOC levels were 1.43 mg/L, 1.28 mg/L, and 1.46 mg/L, respectively.

Groundwater contour maps for the site indicate that the pumping of the EKCO production wells W-1 and W-10 appreciably affects the groundwater flow in the shallow, intermediate, and the bedrock water-bearing zones on-site, as well as in the western edge of the deep sand and gravel aquifer to the east. Groundwater contour maps of these four water bearing units, from water level measurements collected in October 1991, are provided in Figures 1-8 through 1-11 respectively.

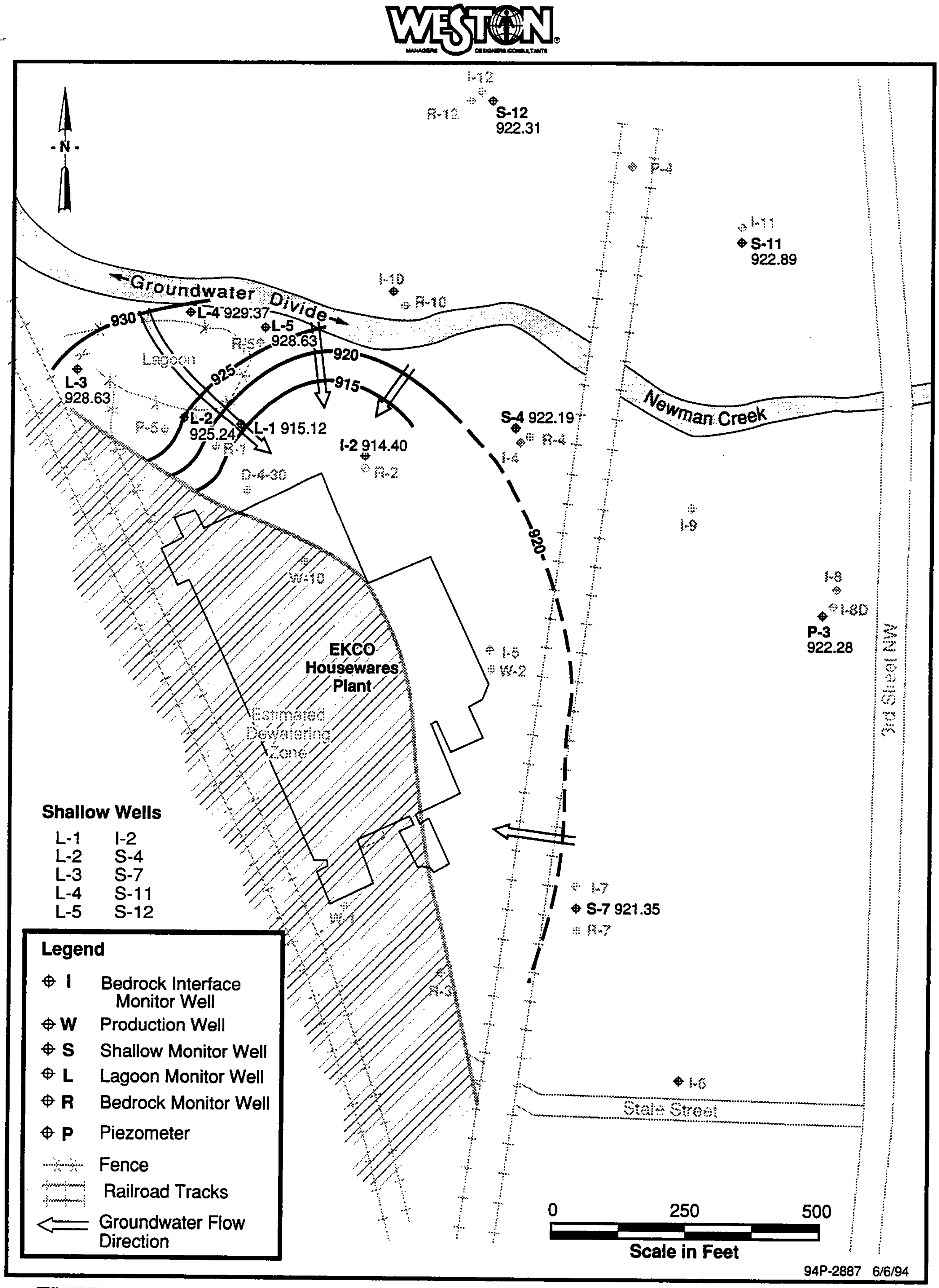


FIGURE 1-8 GROUNDWATER CONTOUR MAP OF WELLS COMPLETED IN THE SHALLOW SAND AND GRAVEL WATER BEARING ZONE, 22 OCTOBER 1991 EKCO HOUSEWARES FACILITY – MASSILLON, OHIO

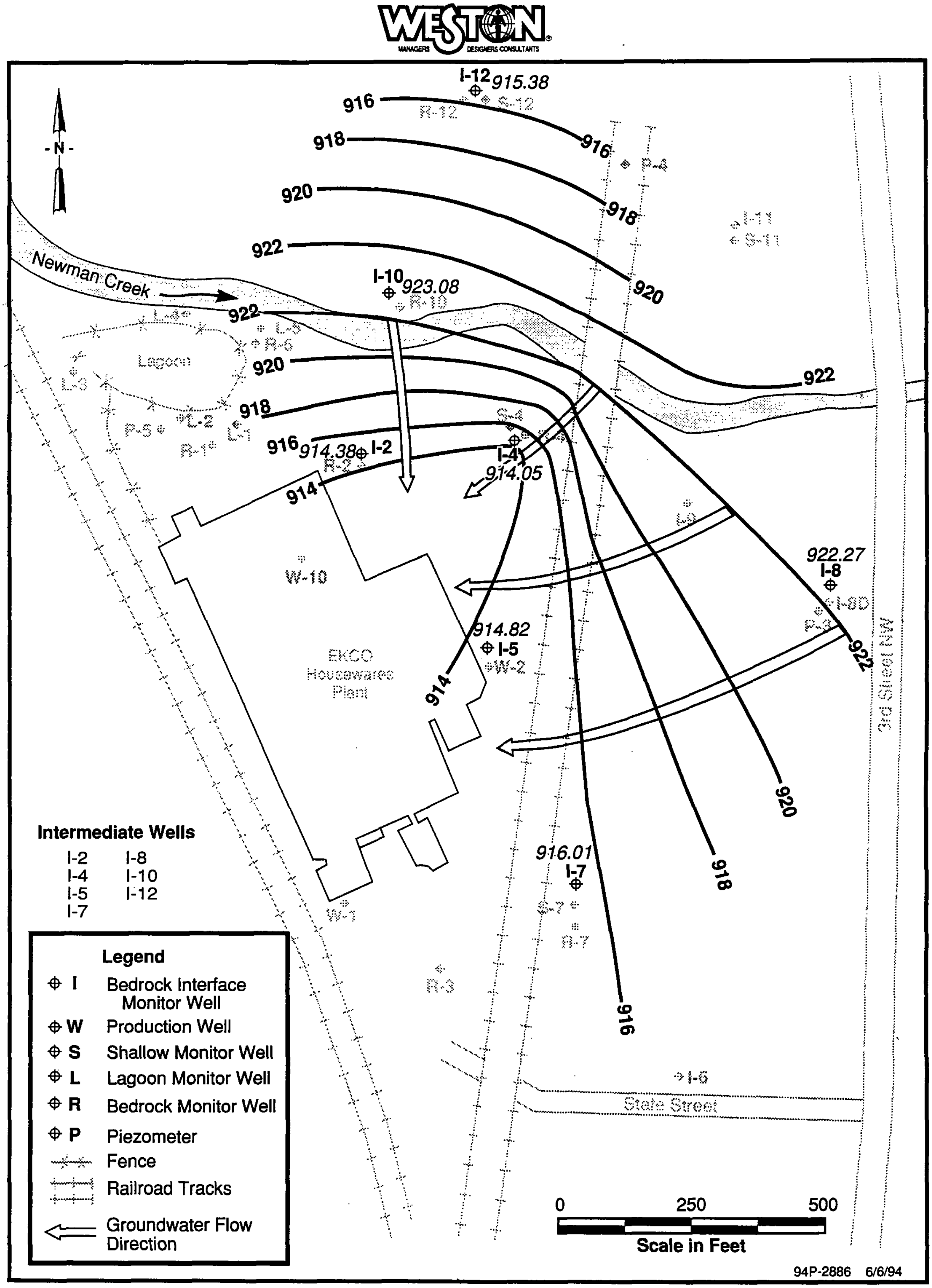


FIGURE 1-9 GROUNDWATER CONTOUR MAP OF WELLS COMPLETED IN THE INTERMEDIATE SAND AND GRAVEL WATER BEARING ZONE, 22 OCTOBER 1991
EKCO FACILITY – MASSILLON, OHIO

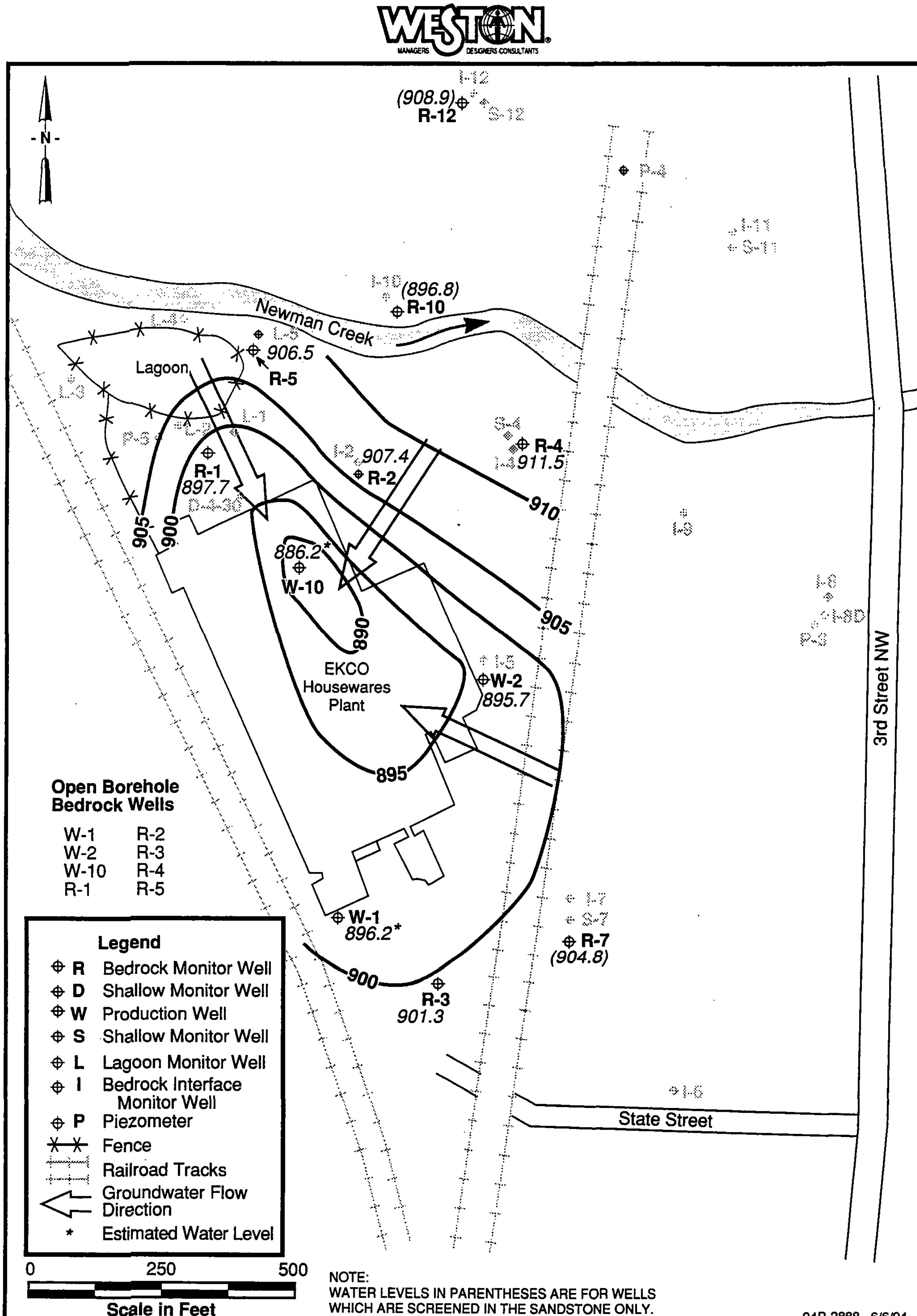


FIGURE 1-10 GROUNDWATER CONTOUR MAP OF WELLS COMPLETED IN THE BEDROCK, WATER LEVELS MEASURED 22 OCTOBER 1991 EKCO HOUSEWARES FACILITY – MASSILLON, OHIO

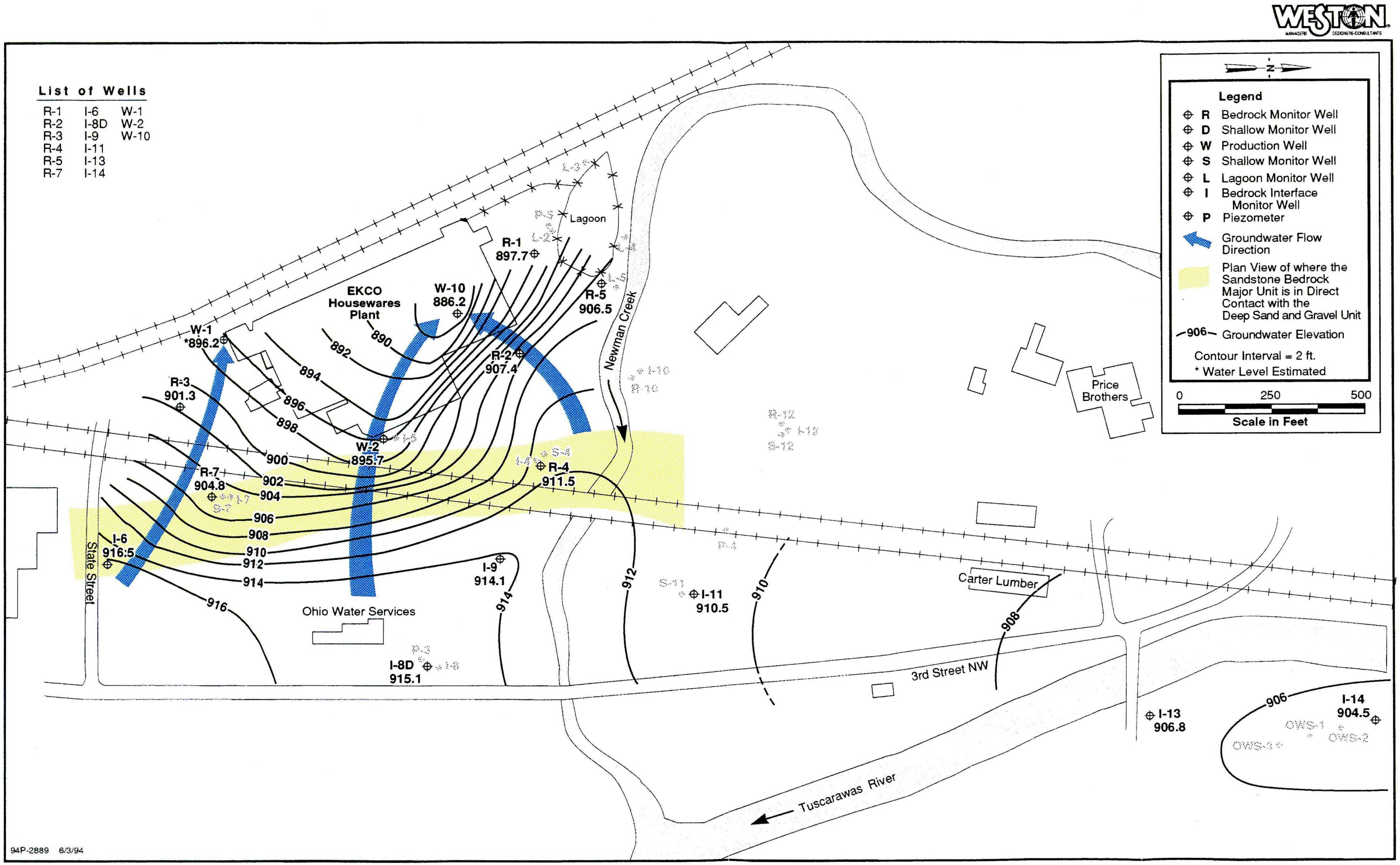


FIGURE 1-11 GROUNDWATER CONTOUR MAP OF WELLS COMPLETED IN THE DEEP SAND AND GRAVEL WATER BEARING ZONE AND IN BEDROCK, 22 OCTOBER 1991
EKCO HOUSEWARES FACILITY, MASSILLON, OHIO

SECTION 2

WELL REHABILITATION ACTIVITIES

This section of the report describes the rationale, procedures and results of the well rehabilitation and abandonment activities conducted at the site from 21 through 30 March, 1994. The scope of work included the following:

1. **Borehole Geophysical Logging:** Wells W-1, W-2, W-10 and R-3 were each logged prior to commencing rehabilitation activities. Geophysical logs of wells R-1 and R-2 were previously available from the packer testing conducted in these wells in 1991. Pulling of the turbine pumps from production wells (W-1, and W-2) and the dedicated sampling pumps from monitoring wells (R-1, R-2 and R-3) was initially performed. Production well W-10 was kept in operation until the rehabilitation work on well W-1 was completed and brought back on-line. The facility utilizes a portion of the treated water from either well W-1 or W-10 for various plant processes.

2. **Casing Liner Installations W-Wells:** Wells W-1, W-2 and W-10 were modified with 8-inch diameter, PVC casing liners beyond the depths of their existing steel casings. Following a minimum curing period of 24 hours, the turbine pumps were reinstalled in wells W-1 and W-10 and brought back on-line as production/recovery wells. Out-of-service well W-2 was fitted with a dedicated sampling pump, locking protective casing and retained for future groundwater monitoring purposes.

3. **Retrofitting R-Wells :** Existing wells R-1, R-2 and R-3 were modified as 2-inch diameter, stainless steel monitoring wells. Each well was retrofitted with screen and sandpack across the productive sandstone unit, sealed to surface with a cement/bentonite grout and developed with a low-flow submersible pump.

4. **Well Abandonment D-4-30 :** Shallow monitoring well D-4-30 was overdrilled and abandoned by tremie grouting a cement/bentonite slurry to surface.

2.1 Borehole Geophysical Logging

A suite of borehole geophysical logs were run in the W-wells and in well R-3 to confirm existing casing depths, casing and open borehole diameters and conditions, and well total depths. In addition, the depths to each of the bedrock stratigraphic lithologies (eg; sandstones and shales) was refined so that the formation packers in the W-wells could be set across low permeability strata, and the screen and sandpacks in the R-wells could straddle the productive sandstone unit. Estimates of grout volumes were calculated from the geophysical logs and the relative degree of loss to the formation and/or casings was derived from the logging results.

2.1.1 Borehole Geophysical Logging - Procedures

All geophysical logging services were provided by Appalachian Geophysical Surveys of Apollo, Pennsylvania. Prior to logging activities at each well, all geophysical probes and downhole tools were decontaminted using an Alconox detergent scrub, steam cleaning and a potable water rinse. The suite of borehole geophysical logs which was run was as follows:

- **Caliper Log** - A 3-arm caliper log was run to provide a continuous record of the average diameter in inches of the open borehole and casing. The closed tool was first run to the bottom of the hole to determine the total depth of the well. The tool was then opened and the mechanical arms maintained against the borehole wall by springs which allowed the arms to open and close with changes in borehole size as the tool moved up the hole at a constant logging speed. All geophysical logs were referenced to the top of the surveyed well casings.

- **Natural Gamma Log** - The gamma log provided a continuous record of the amount of natural gamma radiation emitted by the formations penetrated by each borehole. In general, the gamma activity of clay-bearing sediments and rocks (eg; clays and shales) was higher than those of quartz sands or sandstones. Naturally occurring, gamma-emitting radioisotopes such as potassium-40 and daughter products of the uranium and thorium decay series are generally concentrated in clay, giving fine grained detrital sediments a characteristic signature. The gamma ray probe detects gamma radiation through the use of a passive sodium iodide crystal and scintillation counter. The greater the counting rate, the more events the gamma detector is measuring, which, in turn, corresponds to a higher clay content of the surrounding strata. The gamma tool was run to the bottom of the borehole and recorded at a constant logging speed from the bottom to the top of the well.

- **Resistivity Log** - The resistivity log measured the electrical resistance (in ohms) of the earth materials within each well between two electrodes on the probe. Increases in formation resistance produced corresponding increases in resistivity on the logs. In general, the resistivity log response in resistive rocks (sandstones) and conductive rocks (shales) provides a mirror image of the gamma log under suitable conditions. Because a constant electric current is generated between the two electrodes on the resistivity tool, the log requires a borehole fluid to conduct the current. As a result, the resistivity tool was run from the bottom to the top of the fluid column in each well at a constant logging speed. Repeat logs were run in each well as a quality control check on electrical interference from extraneous or man-made sources.

- **Gamma Gamma Density** - The gamma density log was run primarily to confirm the casing depths of the older, W-wells, which had accumulated excessive iron oxide build-up on the borehole walls. The iron build-up tended to mask the response of the resistivity and caliper logs, making the identification of casing seats difficult. The gamma density log was also useful in refining the lithologic units penetrated by well R-3. In general, the gamma density log response is related directly to electron density, which is approximately proportional to bulk density of the material surrounding the borehole. The gamma density log was recorded with density increasing to the left and porosity increasing to the right. As a precaution, because the gamma density probe is a nuclear source tool, the log was generally not run in the open borehole portion of the W-wells which were dynamited extensively during their installation. The caliper logs of these wells showed numerous borehole enlargements where the dynamite charges were reported to have been set.

Interpretation of the borehole geophysical logs was performed on-site to determine the final casing liner depths, grout volumes, screen depths and sandpack intervals for each well. Hard copies of all geophysical logs are provided as Plate A of this report.

2.1.2 Borehole Geophysical Logging - Results

The results of the borehole geophysical logging revealed several physical characteristics which were consistant to the rocks beneath the site. The sandstones generally exhibited low natural gamma activity (log response to the left) and the shales high gamma activity (log response to the right). The productive sandstone unit beneath the site was identified in each well by corresponding high resistivity on the electric log and low gamma density response (both increases to the right). In general, the major sandstone unit was shown to be approximately 50-60 feet thick and exists between the elevations of 790 and 850 feet MSL. In each of the W-wells, the productive sandstones were also characterized by large caliper log excursions which corresponded favorably with the reported depths of the dynamite charges that were set in these wells to increase their yields. The most reliable indicator of the steel casing depths in each well was the gamma density log. Because the density log was recorded while descending the borehole, the log was kept on-scale when inside the steel casings and deflected off-scale towards lower density response (increase to the right) when the open borehole was encountered. The total depths of each of the newly logged wells were generally less than their original reported depths, averaging almost 20 to 30 feet less in total footage. Table 2-1 provides a comparison of the available drilling data and geophysical logging results for the six wells rehabilitated during the IRM activities. The geologic cross-sections (Figures 1-4 and 1-5) have been revised to include the results of the geophysical logging and the reconfigurations of the rehabilitated wells.

2.2 Casing Liner Installations - W-Wells

Results of packer testing, geophysical logging and review of historical well records suggested that these wells may have had leaking annular seals and/or possessed deteriorated steel casing due to age or lack of casing grout (the W-wells are all more than 40 years old). Because of the presence of VOCs in the shallow aquifer groundwater and soils in the vicinity of these wells, concern existed that these wells may have been providing vertical migration pathways for contamination to the bedrock aquifer beneath the site. Installation

Table 2-1

Summary of Borehole Geophysical Logging Results, March 1994 - EKCO Housewares Facility

Well No.	Casing Depth (ft BGS)	Casing Diameter (inches)	Open Hole Total Depth (ft BGS)	Open Hole Diameter (inches)	*Major Sandstone Interval (ft BGS)	*Major Sandstone Elevation (ft MSL)
W-1	28	12.5	205(G) 225(D)	11.75	115-165	783-833
W-2	90	12.5	204(G) 231(D)	11.75	90-145	801-856
W-10	44	10	158(G)	9.75	88-148	795-855
R-1	42	6.5	167(G)	6	102-142	800-844
R-2	46	6.5	153(G)	6	87-147	802-852
R-3	36	6.5	143(G) 175(D)	6	92-144	802-854

* The majority of the groundwater yield in the site bedrock wells is produced from this sandstone unit.

Notes: Geophysics results for wells R-1 and R-2 are from 1991

BGS - Below Ground Surface
TOC - Top of Casing
MSL - Mean Sea Level
D - Driller's Log
G - Geophysics

and grouting of PVC liners in the wells, beyond the depths of the deteriorated casings, would seal off any potential leaks either at the casing shoe (annular pathway) or along the casings length (corrosion leaks). Proper sealing of the wells in this fashion would isolate and protect the bedrock aquifer from shallow source contamination, and extend the life of the production/recovery wells. Additionally, by isolating the bedrock zone from the overlying shallow groundwater units, more efficient recovery and treatment of bedrock groundwater would be achieved, thereby reducing the time and volume of extracted groundwater required to clean-up the bedrock aquifer.

2.2.1 Casing Liner Installations W-Wells - Procedures

All well rehabilitation services and supplies were provided by Frontz Drilling Inc., of Wooster, Ohio. Prior to liner installation activities, all downhole tools and well materials were decontaminated using an Alconox detergent scrub, steam cleaning and potable water rinse. Installation of the liners in the W-wells involved the following sequential steps:

1. Rubber formation packers were attached to the end of the 8-inch diameter (O.D.), flush-threaded, PVC casing using stainless steel clamps. The casing was then suspended above the wellbore and the packer filled with granular bentonite prior to being lowered downhole.

2. The 10-foot lengths of casing were threaded together and lowered downhole to the depth selected from the geophysical logs. In general, the liner depths were required to be beyond the depths of the existing steel casings, below the static water level in the wells and within a competent borehole section.

3. Once the liner was set at the desired depth, approximately 1 foot of medium-grained sand was emplaced above the bentonite in the formation packer to provide a cushion against which to grout. A 1-inch diameter, PVC tremie pipe was lowered down the annulus between the liner and the steel well casing, and the sandpack was tagged to confirm the packer setting and to commence grouting.

4. The theoretical grout volume was determined by calculating the gallons per linear foot between the PVC liner and the steel casing and open borehole, and multiplying by the depth setting of the formation packer. The grout mixture consisted of Type I/II Portland cement with 4% bentonite powder and 7.8 gallons of potable water per 94 lbs. sack of cement. This mixture yielded a grout slurry, fully hydrated, of 11.59 gallons per sack of cement.

5. The theoretical volume required to grout the liner to surface was tremie grouted from the formation packer on up the hole and the level of the displaced formation water was carefully monitored. If grout returns to surface were achieved and the level of the grout stabilized at the surface, the liner installation was considered complete. If grout returns to surface were not achieved, the grout was allowed to cure overnight and a 2nd stage of cementing was initiated.

Once liner installations and grouting was complete, the submersible pumps were re-installed in wells W-1 and W-10 and the wells were brought back on-line. A dedicated submersilble pump was installed in well W-2 and the well was purged of one complete well volume for development purposes. To facilitate the collection of pumping water levels in the W-wells, 1-inch diameter, PVC drop pipes were installed in each well to a depth setting just above the respective well pumps. The drop pipes (stillwells) were intended to allow easy access of water level probes into the wells and for preventing the probes from becoming stuck or hung-up on the pump hardware downhole. In the past, collection of accurate pumping water levels in the site recovery wells had been difficult.

2.2.2 Casing Liner Installations W-Wells - Results

The results of the liner installations indicated that in production/recovery well W-1, significant breaks or leaks existed in the casing at a depth of approximately 24 ft. The 1st stage of grouting in well W-1 did not achieve displacement of formation water or grout returns to surface, and the grout was tagged the next day at a depth of 24 feet (BGS). This well required nearly twice the theoretical volume of grout volume to finally achieve stabilized grout returns to surface during the 2nd stage of cementing. A sizeable washout zone potentially existed in the annulus of the steel casing in this well, which would account for the excessive grout volumes required. The grout volumes required for the liner installations in wells W-10 and W-2 were each close to their theoretical volumes which indicate that no apparent leaks were present in either of these wells steel casings. Table 2-2 presents the configurations of the rehabilitated W-wells and the respective grout volumes required for each of the liner installations.

Table 2-2

Configurations of Rehabilitated W-Wells at the EKCO Housewares Facility, Massillon, Ohio

Well No.	Static Depth to Water (ft TOC)	*PVC Liner Depth (ft TOC)	PVC Liner I.D./O.D. (Inches)	Steel Casing Depth (ft TOC)	Steel Casing I.D.	Theoretical Slurry Volume (gal.)	Actual Slurry Volume (gals.)
W-1	41.9	49.0	8.0/8.5	28	12.5	157.5	301
W-2	36.7	99	8.0/8.5	90	12.5	328.3	320
W-10	34.5	45	8.0/8.5	44	10.0	46	47

Note: Slurry mixture was 4% Bentonite by weight with Class I/II Portland cement and 7.8 gallons of water per sack of cement. The yeild of the slurry mixture, when fully hydrated, was 11.59 gallons per sack of cement.

O.D. - Outside Diameter
I.D. - Inside Diameter
BGS - Below Ground Surface
TOC - Top of Steel Casing
PVC - Casing Outside Diameter 8.5 inches

* Casing liner depth corresponds to the formation packer setting above which the cement/bentonite slurry was emplaced

2.3 Retrofitting R-Wells

Results of packer testing, casing integrity testing, geophysical logging and drilling records for the R-wells suggested that wells R-1, R-2 and R-3 may have had leaking casing seats due to lack of grout in the annular spaces behind the casings. Because of the presence of elevated levels of VOCs in the shallow groundwater in the vicinity of these wells, concern existed that these wells were providing vertical migration pathways for contamination from the shallow overburden directly to the bedrock aquifer beneath the site. During the packer testing of wells R-1 and R-2, suppressed hydraulic head differentials between the shallow overburden and bedrock groundwater indicated that a breach in the confining units (shales and argillaceous sandstones) may have existed in the area of these wells. Retrofitting wells R-1 through R-3 by screening the productive sandstone unit, and sealing off the overlying low permeability bedrock units and steel casing, would effectively isolate the shallow groundwater contamination and protect the bedrock aquifer from further impacts. The rehabilitation of these R-wells would also restore the natural hydraulic gradients and heads in each groundwater zone.

2.3.1 Retrofitting R-Wells - Procedures

Retrofitting of the R-wells initially involved backfilling the base of the boreholes with coarse-grained, washed gravel from the base of the boreholes up to a level where the medium-grained sandpack would be emplaced. In the IRM Work Plan, it was proposed that the base of the boreholes be filled with a cement/bentonite plug. However, a field decision was made to propose backfilling of the base of the boreholes with gravel for the following reasons:

- A cement plug at the base of the screens in the modified wells could potentially alter the pH significantly and affect the geochemistry of the groundwater in the well.
- The precision and depth control of emplacing gravel backfill would be much greater than attempting a grout plug.

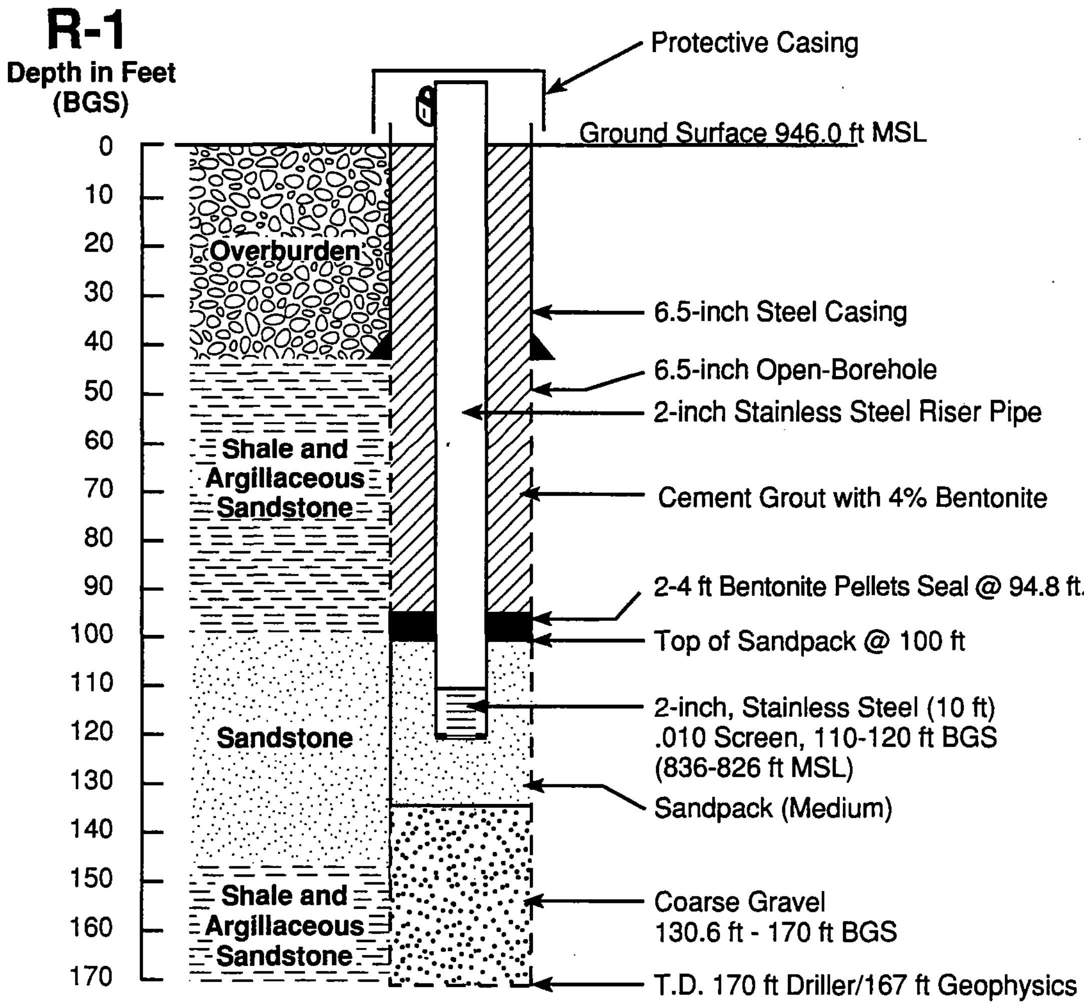
This field modification to the scope was communicated to EPA Region V via the on-site oversight contractor for EPA. Approval of the modification to the scope was granted base on EPA's concurrance with the rationale set forth above.

Installation of the 2-inch diameter screen (10 foot length in each well) and riser, involved suspending the well materials in tension until sandpacking of the screen and grouting of the riser was completed. Holding the well in tension in this manner insured a plumbed well. Additionally, 2 stainless steel centralizers were attached to the well and set at a diameter of 5-inches. Each well was sandpacked with Sidley 1020 sand (medium-grained) from the top of the gravel backfill to approximately 10 feet above the top of the 2-inch well screen. Once the sandpack was in place and fully settled, a 1-2 foot thick bentonite seal was emplaced above the sandpack and allowed to hydrate overnight. The wells were subsequently tremie grouted from the top of the bentonite seal to groundsurface. As with the grouting of the W-wells liners, the grouting of the R-wells was performed in a staged manner to minimize formation loss and to assess the magnitude of grout loss behind the steel casings. A 4% cement/bentonite slurry was also used in the sealing of the R-wells between the 2-inch risers and the 6-inch borehole and steel casing. After a minimum curing period of 24 hours for the 1st stage of grout, each R-well was developed and purged of 3 to 5 well volumes using a low-flow submersible pump. Schematic representations of each retrofitted R-well are provided in Figures 2-1 through 2-3.

2.3.2 Retrofitting R-Wells - Results

The actual grout volumes required to seal the annular spaces between the 2-inch risers and the 6-inch boreholes and casings in the R-wells, far exceeded the theoretical volumes which were calculated. This finding was consistant with the packer testing results which indicated that significant flow existed at the casing seat in well R-2, and that the same situation potentially existed in wells R-1 and R-3. The discrepancies between the theoretical and actual grout volumes required for each R-well were as follows:

- Well R-1 required 162 gallons of grout, pumped in 2 stages, compared to the theoretical volume of 116 gallons.

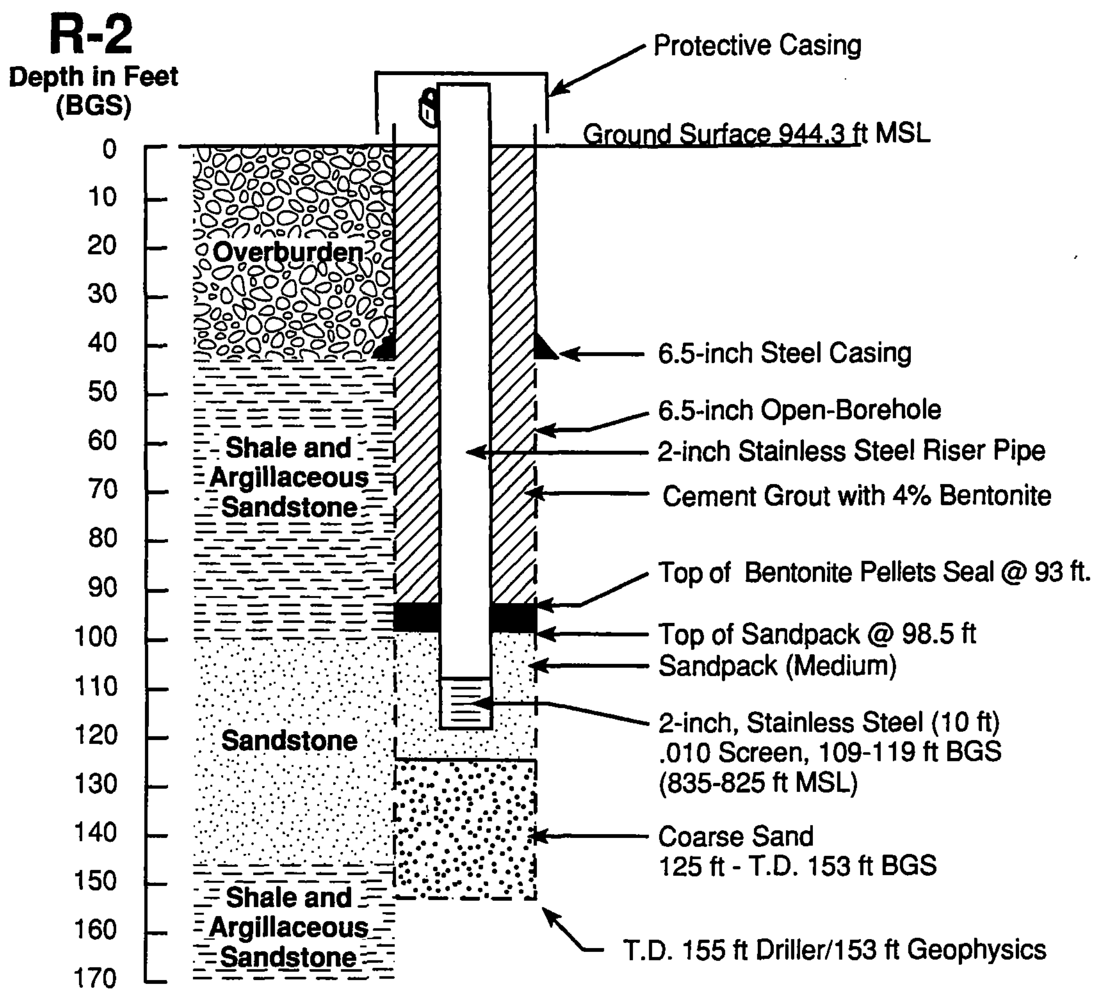


WELL STATISTICS

Casing Stickup: 0.9 ft
Drilling Method: Rotary
Date Drilled: 25 October 1984
6.5-in Casing set @ 42 ft BGS
Top of Bedrock @ 41 ft BGS

94P-2974 6/9/94

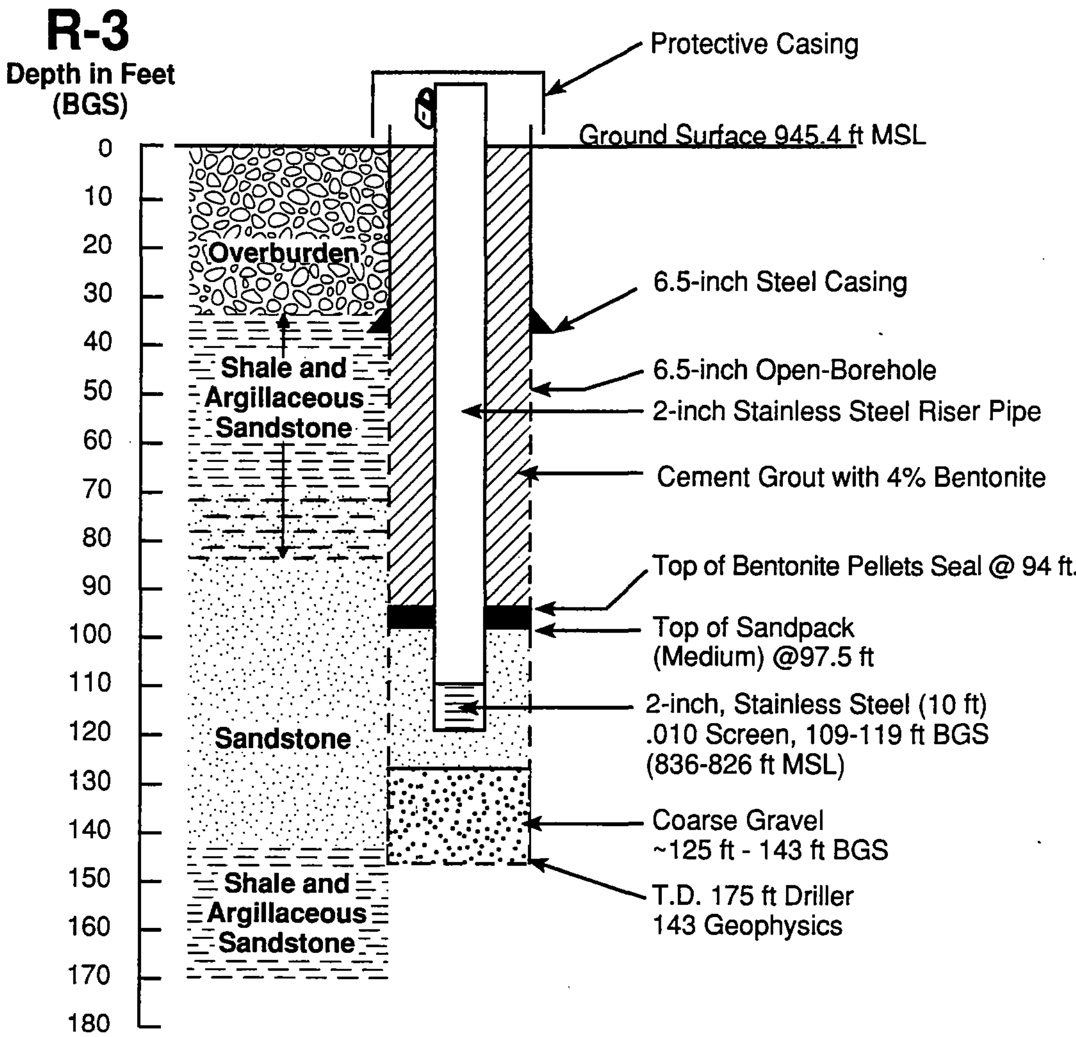
FIGURE 2-1 SCHEMATIC OF RETROFITTED WELL R-1, EKCO HOUSEWARES, MASSILLON, OHIO



WELL STATISTICS
Casing Stickup: 2.2 ft
Drilling Method: Rotary
Date Drilled: 29 October 1984
6.5-in Casing set @ 46 ft BGS
Top of Bedrock @ 44 ft BGS

94P-2975 6/9/94

FIGURE 2-2 SCHEMATIC OF RETROFITTED WELL R-2, EKCO HOUSEWARES, MASSILLON, OHIO



WELL STATISTICS

Casing Stickup: 1.74 ft
Drilling Method: Rotary
Date Drilled: 30 October 1984
6.5-in Casing Set @ 37 ft BGS
Top of Bedrock @ 32 ft BGS

94P-2976 6/9/94

FIGURE 2-3 SCHEMATIC OF RETROFITTED WELL R-3, EKCO HOUSEWARES, MASSILLON, OHIO

- Well R-2 required 185 gallons of grout, pumped in 2 stages, compared to the theoretical volume of 114 gallons.

- Well R-3 required 139 gallons of grout, pumped in 2 stages, compared to the theoretical volume of 116 gallons.

2.4 Abandonment of Well D-4-30

Shallow well D-4-30 was installed in 1987 (along with 3 other D-wells), to evaluate hydraulic conditions around the lagoon for RCRA compliance monitoring purposes. However, the newer lagoon wells (L-wells) currently serve as replacements for the D-wells, all of which, save D-4-30, have since been abandoned. These wells were all completed in fine grained sediments and were not designed for long term compliance monitoring. Well D-4-30 was retained because of its strategic location on-site (proximity to VOC source areas). Well D-4-30 was no longer used for water-level measurements due to the poor condition of the surface seal and damaged wellhead riser, and was therefore proposed for abandonment.

The well was overdrilled to its total depth (20 feet) using 4.25-inch, hollow-stem augers. Once all well materials were removed by the drilling process, the auger plug was removed and the boring was tremie grouted from the base of the borehole to ground surface. The volume of grout required to abandon the wellbore was approximately 45 gallons.

SECTION 3

POST-REHABILITATION WATER LEVEL MONITORING

This section of the report describes the results of the post-rehabilitation groundwater monitoring activities conducted at the EKCO site from 7 throught 29 March, 1994. The purpose of the post-rehabilitation groundwater monitoring was to assess what effects, if any, the IRM activities had on the groundwater levels and gradients in the four water bearing units in the vicinity of the site.

3.1 Water Level Monitoring - Procedures

Following completion of the well rehabilitation activities, water level measurements were collected from all on-site and off-site monitoring wells, production/recovery wells and Neuman Creek staff gages, once per week for 4 successive weeks. Additionally, flow meter readings were collected from production/recovery wells W-1 and W-10 as part of this effort.

Water level measurements were collected from each well using an electronic water level probe. All depth to water measurements were referenced to the surveyed top of casing at each well or from a surveyed water level monitoring port (W-wells). The water level measurements were converted to elevations above Mean Sea Level (MSL) and tabulated for generating groundwater contour maps. The water level measurements collected during this effort are provided in Table 3-1. Groundwater contour maps for the shallow and intermediate sand and gravel and the bedrock water bearing units on site are provided as Figures 3-1 through 3-3 respectively. An additional groundwater contour map of the deep sand and gravel and bedrock water bearing units is provided as Figure 3-4. The extent of the erosional surface where the productive sandstone unit subcrops and is in direct contact with the deep sand and gravel unit is also depicted on Figure 3-4 (and Figure 1-4). For discussion purposes, only the last round (29 April, 1994) of post-rehabilitation water levels was contoured for this report as these water levels would be the most representative of equilibrium conditions.

Table 3-1

WATER LEVEL MEASUREMENTS
EKCO HOUSEWARES
APRIL 1994

WELL ID	TOC ELEV.	4/7/94 DTW	4/7/94 ELEV.	4/14/94 DTW	4/14/94 ELEV.	4/20/94 DTW	4/20/94 ELEV.	4/29/94 DTW	4/29/94 ELEV.
SHALLOW SAND AND GRAVEL									
I-2	946.40	26.89	919.51	25.04	921.36	24.66	921.74	25.26	921.14
L-1	946.33	20.58	925.75	18.39	927.94	19.15	927.18	19.56	926.77
L-2	947.57	15.37	932.20	14.30	933.27	14.93	932.64	15.53	932.04
L-3	946.91	14.65	932.26	13.04	933.87	14.02	932.89	14.82	932.09
L-4	938.22	6.90	931.32	5.73	932.49	7.87	930.35	8.08	930.14
L-5	936.98	6.10	930.88	4.74	932.24	7.15	929.83	7.29	929.69
P-3	933.68	7.68	926.00	4.04	929.64	7.15	926.53	8.55	925.13
S-4	934.88	9.23	925.65	4.73	930.15	8.13	926.75	9.57	925.31
S-7	940.94	16.44	924.50	12.93	928.01	14.48	926.46	16.17	924.77
S-11	934.04	7.04	927.00	1.61	932.43	5.23	928.81	7.69	926.35
S-12	944.93	19.74	925.19	16.31	928.62	17.35	927.58	19.15	925.78
SG-1	934.17	NM	NM	0.45	933.72	2.65	931.52	2.90	931.27
SG-2	933.33	NM	NM	0.54	932.79	2.80	930.53	3.20	930.13
SG-3	932.45	NM	NM	3.96	928.49	2.85	929.60	3.10	929.35
SG-4	STAFF GAGE MISSING								
SG-5	939.19	NM	NM	5.92	933.27	10.58	928.61	11.11	928.08
INTERMEDIATE SAND AND GRAVEL									
I-2	946.40	26.89	919.51	25.04	921.36	24.66	921.74	25.26	9[illegible]
I-4	933.23	13.85	919.38	11.75	921.48	11.38	921.85	12.12	9[illegible]
I-5	946.13	26.24	919.89	24.32	921.81	24.05	922.08	24.72	92[illegible]
I-7	940.04	19.85	920.19	17.71	922.33	17.53	922.51	18.03	92[illegible]
I-8s	931.51	3.51	928.02	1.85	929.68	4.98	926.55	6.35	92[illegible]
I-10	935.79	8.64	927.15	5.76	930.03	7.94	927.85	9.08	92[illegible]
I-12	944.54	21.68	922.86	17.52	927.02	18.86	925.68	20.93	923[illegible]
DEEP SAND AND GRAVEL									
I-6	940.62	19.62	921.00	17.72	922.90	17.46	923.16	18.38	922.[illegible]
I-8d	933.46	13.53	919.93	11.51	921.95	11.12	922.34	11.92	921.5[illegible]
I-9	932.17	12.88	919.29	10.98	921.19	10.34	921.83	11.08	921.0[illegible]
I-11	933.42	16.70	916.72	14.81	918.61	13.07	920.35	14.53	918.8[illegible]
I-13	933.47	18.95	914.52	NM	NM	14.33	919.14	16.19	917.28
I-14	932.33	19.91	912.42	NM	NM	13.29	919.04	17.34	914.99
BEDROCK									
R-1	946.55	52.98	893.57	51.92	894.63	51.03	895.52	51.08	895.47
R-2	946.02	54.25	891.77	52.62	893.40	51.74	894.28	52.05	893.97
R-3	946.89	53.25	893.64	52.35	894.54	51.85	895.04	51.98	894.91
R-4	933.28	16.53	916.75	14.62	918.66	14.13	919.15	14.86	918.42
R-5	937.79	26.53	911.26	25.53	912.26	25.29	912.50	25.57	912.22
R-7	941.55	32.22	909.33	30.81	910.74	30.23	911.32	30.67	910.88
R-10	935.80	32.93	902.87	31.24	904.56	29.94	905.86	30.93	904.87
R-12	945.35	29.97	915.38	27.98	917.37	26.05	919.30	27.47	917.88
W-1	947.79	124.40	823.39	124.62	823.17	124.55	823.24	124.65	823.14
W-2	945.59	17.58	928.01	25.92	919.67	29.71	915.88	32.96	912.63
W-10	942.79	80.89	861.90	77.61	865.18	77.62	865.17	65.25	877.54

NM Not Measured

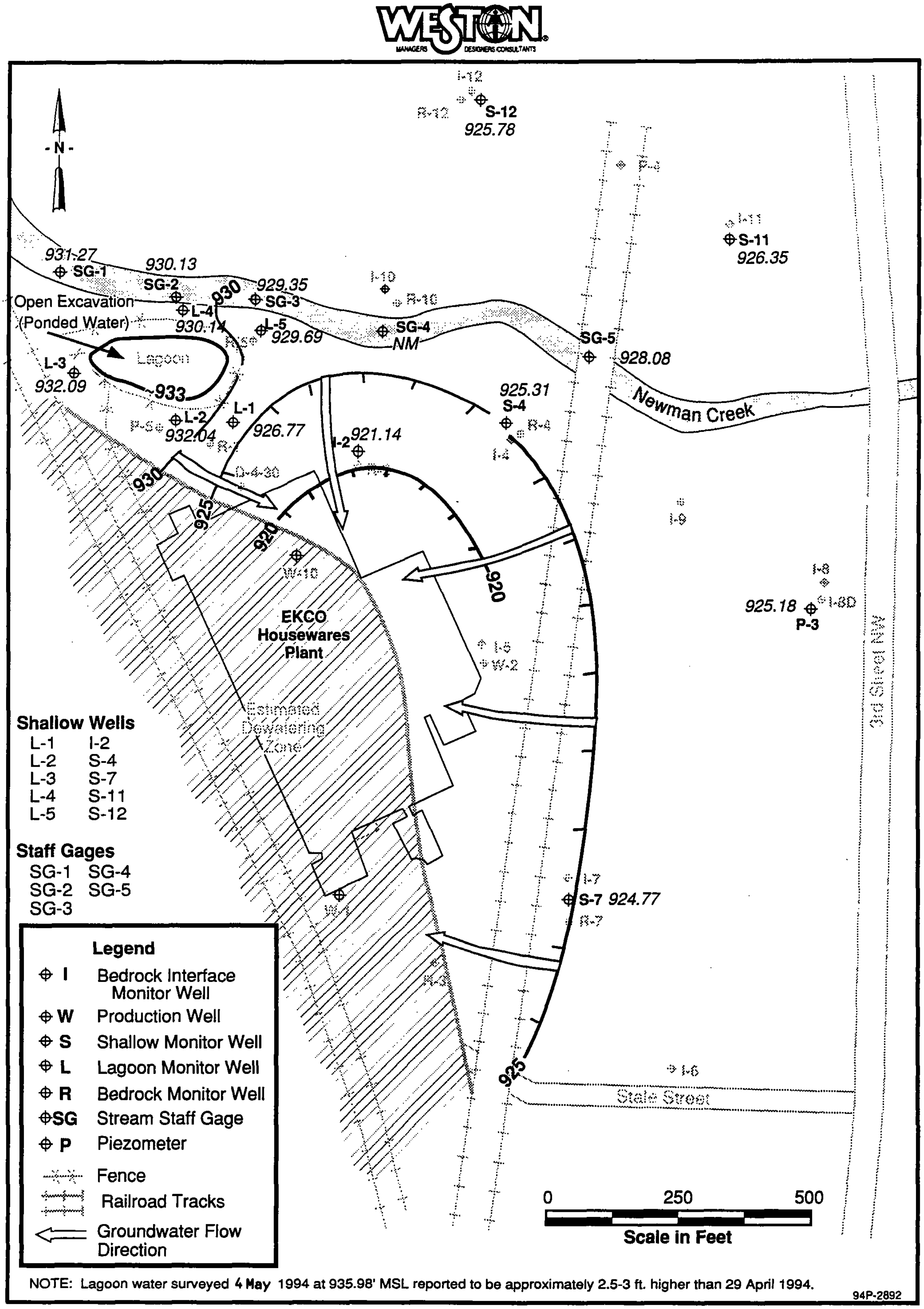


FIGURE 3-1 GROUNDWATER CONTOUR MAP OF WELLS COMPLETED IN THE SHALLOW SAND AND GRAVEL WATER BEARING ZONE – 29 APRIL 1994 EKCO HOUSEWARE FACILITY – MASSILLON, OHIO

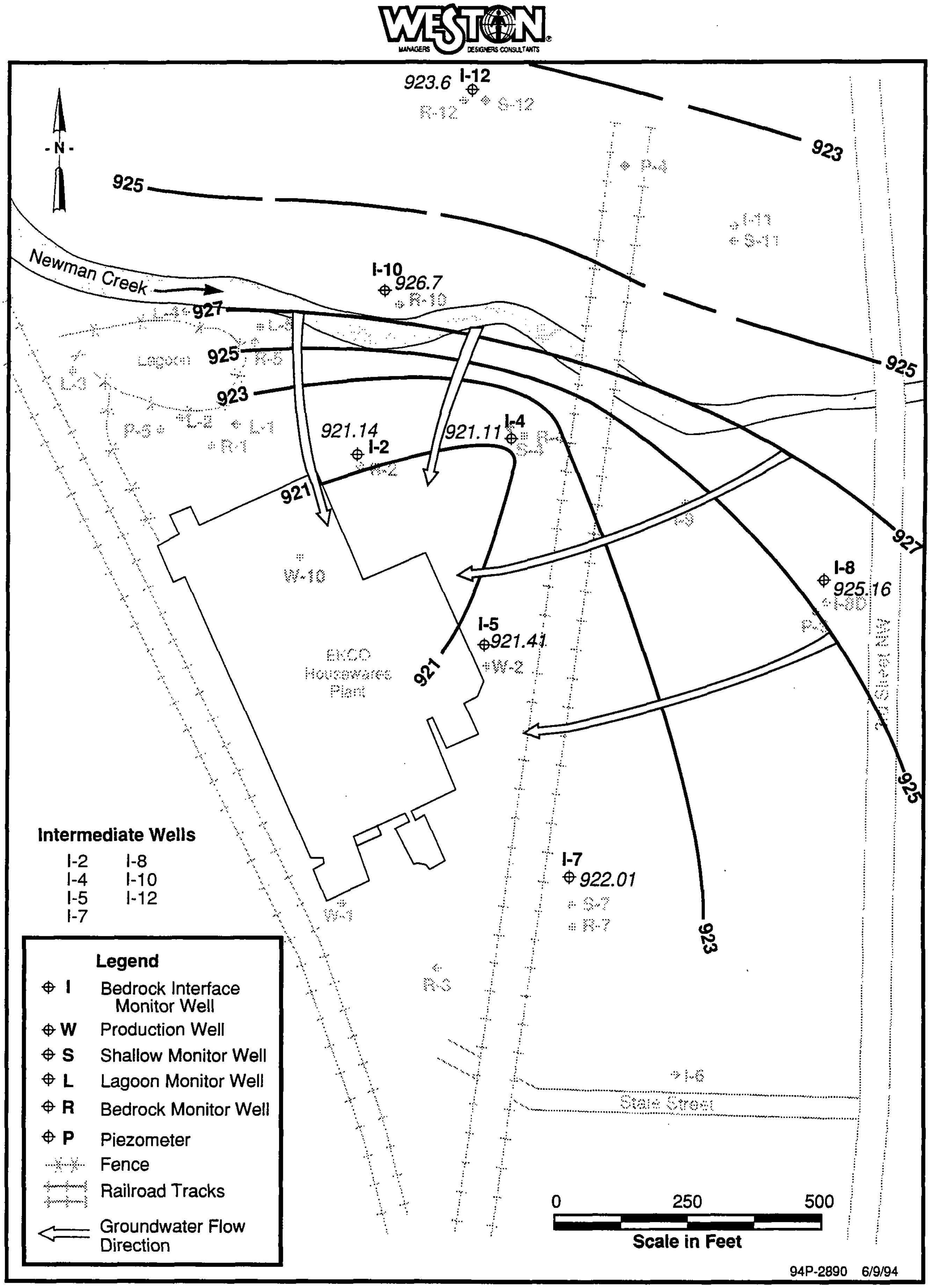


FIGURE 3-2 GROUNDWATER CONTOUR MAP OF WELLS COMPLETED IN THE INTERMEDIATE SAND AND GRAVEL WATER BEARING ZONE, WATER LEVELS MEASURED 29 APRIL 1994 EKCO FACILITY – MASSILLON, OHIO

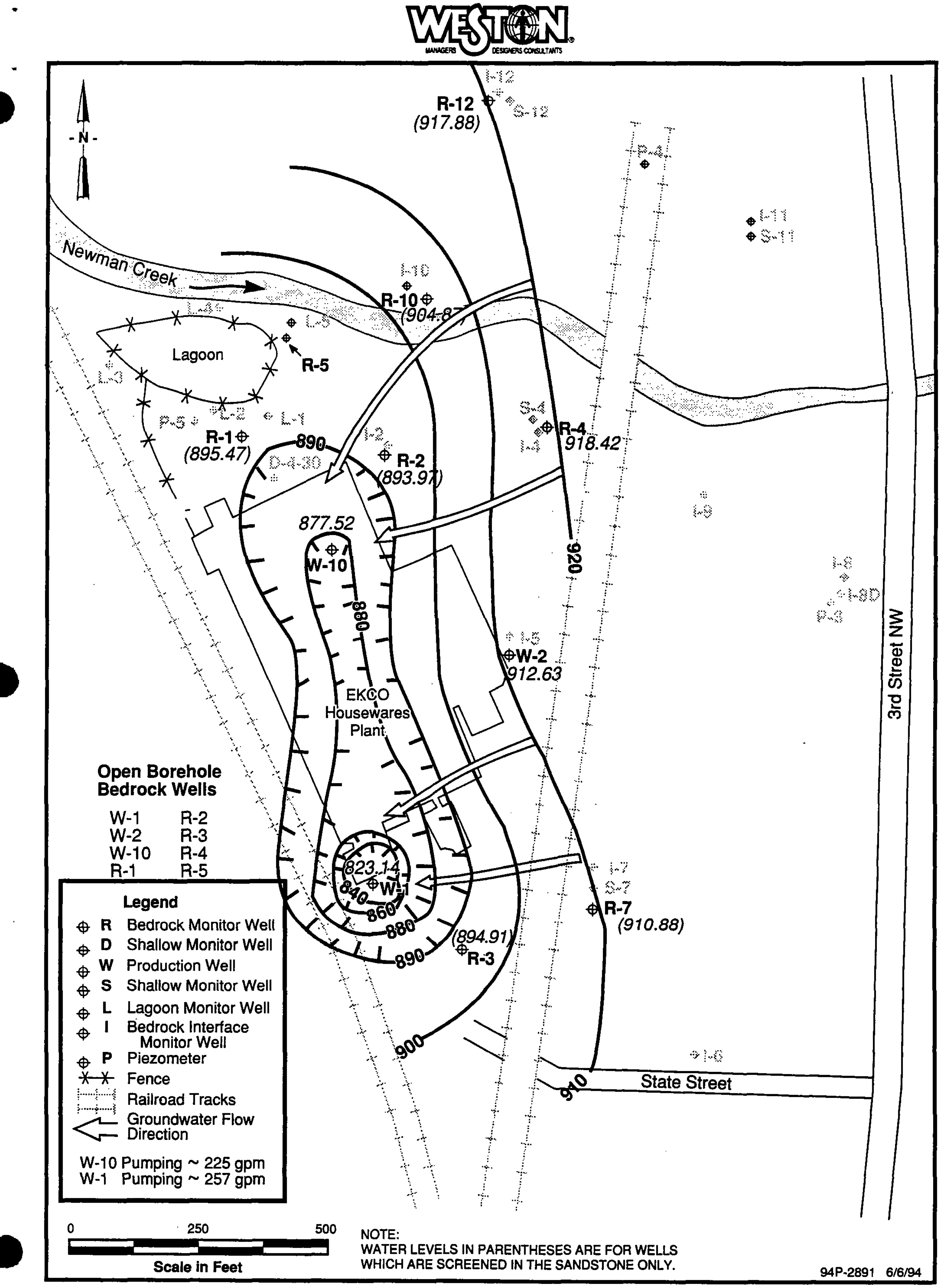


FIGURE 3-3 GROUNDWATER CONTOUR MAP OF WELLS COMPLETED IN THE BEDROCK, 29 APRIL 1994 EKCO HOUSEWARES FACILITY – MASILLON, OHIO

WESTON
MANAGERS DESIGNERS/CONSULTANTS

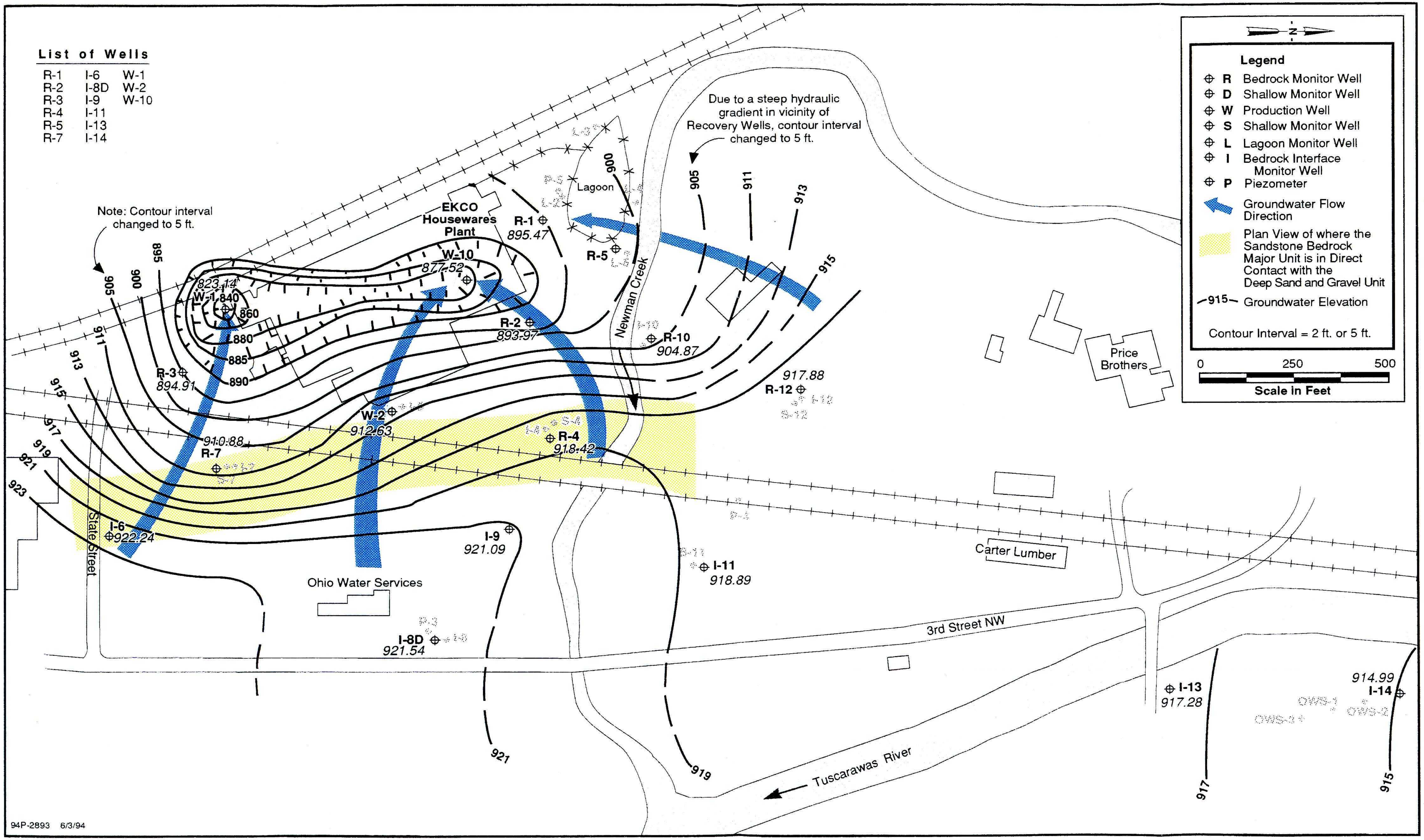


FIGURE 3-4 GROUNDWATER CONTOUR MAP OF WELLS COMPLETED IN THE DEEP SAND AND GRAVEL AND BEDROCK WATER BEARING ZONE–29 APRIL 1994 EKCO FACILITY, MASSILLON, OHIO

3.2 Water Level Monitoring - Results

The results of the post-rehabilitation groundwater monitoring indicated that the groundwater flow direction in the 4 primary water bearing units in the area of the site continues to be towards the site production/recovery wells W-1 and W-10. The most significant changes in groundwater levels occurred in the bedrock water bearing zone. Specifically, the retrofitted R-wells exhibited significant drops in water level elevations, indicating that hydraulic communication to the overlying shallow water bearing zone had been eliminated as a result of the IRM efforts. In general, all four of the water bearing units experienced rising and falling water level trends during the month of April 1994 with the high water mark in the shallow zone occurring the week of 14 April, and the high water mark in the remaining 3 deeper water bearing units occurring the week of 20 April. The fluctuations in water levels appear to be the result of the heavy precipitation which occurred during this period, and the week of delayed recharge to the 3 deeper water bearing units is typical for semi-confined and confined aquifers.

3.2.1 Shallow Sand and Gravel Unit - Results

The groundwater contour map for the shallow sand and gravel indicates that the groundwater flow direction in this unit continues to be towards site recovery wells W-1 and W-10 (Figure 3-1). In the northern portion of the site, the calculated horizontal hydraulic gradients ranged from 0.022 to 0.030 ft/ft. A portion of the hydraulic gradient in this northern area of the site may be attributable to natural gradients flowing away from Neuman Creek both to the north and south. Comparison of staff gage measurements in the creek to shallow wells in this area suggests the creek may be a losing stream. In the southern portion of the site the calculated horizontal hydraulic gradient was approximately 0.039 ft/ft. In this southern portion of the site, the shallow groundwater gradients appear to be influenced by the pumping of the on-site recovery wells as the erosional bedrock surface subcrops in contact with the shallow overburden units in the area of the southern site boundary (see cross-section B-B, Figure 1-5).

3.2.2 Intermediate Sand and Gravel Unit - Results

The groundwater contour map for the intermediate sand and gravel indicates that the groundwater flow direction in this unit continues to be towards site recovery wells W-1 and W-10 (Figure 3-2). In the northern portion of the site , the calculated horizontal hydraulic gradient was approximately 0.021 ft/ft. In the southeastern portion of the site, the calculated horizontal hydraulic gradient was approximately 0.005 ft/ft.

3.2.3 Bedrock Unit - Results

The groundwater contour map for the bedrock indicates that the groundwater flow direction in this unit continues to be towards site recovery wells W-1 and W-10 (Figure 3-3). In the northern portion of the site, the calculated horizontal hydraulic gradients ranged from 0.10 to 0.08 ft/ft towards recovery well W-10. In the southern portion of the site the calculated horizontal hydraulic gradients were greater, ranging from 0.20 to 0.35 ft/ft towards recovery well W-1. The addition of water level drop-pipes (stillwells) in the recovery wells during liner installations made the collection of accurate pumping water levels more feasible than in the past, (especially in well W-1). As shown in Figure 3-3, a large composite cone of depression exists on the potentiometric groundwater surface of the bedrock unit as a result of the combined pumping of wells W-1 and W-10 (257 gpm and 225 gpm respectively).

Post-rehabilitation monitoring also indicates that the degree of hydraulic separation between the shallow sand and gravel unit and the bedrock unit has been significantly increased as a result of retrofitting the R-wells. A comparison of historical groundwater elevations between shallow well I-2 and bedrock well R-2 indicates that the head differentials between these adjacent wells increased by approximately 22 feet as a result of rehabilitation. Comparison of historical groundwater elevations between shallow well L-1 and bedrock well R-1 indicates that the head differentials between these adjacent wells increased by approximately 14 feet as a result of rehabilitation.

3.2.4 Deep Sand and Gravel Unit - Results

The groundwater contour map for the deep sand and gravel indicates that in the areas near the sandstone/deep unit contact, groundwater continues to flow west towards the EKCO site as a result of the pumping of recovery wells W-1 and W-10 (Figure 3-4). Farther away from the site, near wells I-11 and I-13, groundwater flow in the deep sand and gravel unit continues to be governed by the OWS wells which pull groundwater to the north. The calculated horizontal hydraulic gradients towards the site ranged from 0.05 ft/ft in the vicinity of well I-6, to 0.015 ft/ft in the vicinity of well I-9.

SECTION 4

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the IRM activities, the following conclusions and recommendations have been developed for the site.

4.1 Conclusions

- Significant quantities of grout (twice the theoretical volume) were required for the liner installation in well W-1, suggesting that a sizeable washout existed behind the original steel casing in this well. The grout loss was documented as having migrated into a leak in the casing at approximately 24 feet BGS. The grout volumes required for the liner installations for wells W-2 and W-10 were each close to the theoretical volumes, indicating that no significant leaks existed in these wells.

- The quantities of grout required for the retrofitting of wells R-1, R-2 and R-3 ranged between 40% and 60% over the theoretical volumes, confirming that each of the well casings had leaking seals as indicated from the packer testing in 1991.

- Results of the post-rehabilitation water level monitoring indicated that the groundwater flow direction in the 4 primary water bearing units in the area of the site continues to be towards the site production/recovery wells W-1 and W-10. Significant drops in water levels did occur in the bedrock water bearing zone, specifically in the retrofitted R-wells, while the shallow groundwater levels remained unchanged. As a result, the hydraulic head differentials between the shallow groundwater and bedrock groundwater increased, suggesting that hydraulic communication between these zones had been eliminated as a result of the IRM efforts.

4.2 Recommendations

- The results of the IRM activities suggests that, along with the isolation of the bedrock water bearing zone from the overlying shallow groundwater zone, the groundwater pumping of recovery wells W-1 and W-10 will be more concentrated on the bedrock aquifer and accelerated clean-up may result. Additionally, with the elimination of leakage in the bedrock wells casings in the areas of shallow groundwater contamination, further impacts to the bedrock groundwater should not occur. Additional groundwater sampling should be performed to assess what the effects of the IRM activities are on groundwater quality. It is anticipated that the most pronounced effects will be on the bedrock groundwater quality and less on the overlying units.

- A more efficient groundwater remediation approach should be considered for the shallow water bearing zone on-site. The shallow groundwater is the most heavily impacted unit on-site (specifically just north of the plant building). While shallow groundwater does not flow off-site and shallow wells at the property boundary have historically been non-detect for VOCs, the remediation of shallow groundwater in the areas of concern on-site is still warranted.

DRAFT INTERIM RFI
PACKER TEST REPORT

EKCO HOUSEWARES, INC.
MASSILON, OHIO

July 1991

JULY 1991

H. G. Byer
Project Manager

Technical Manager

Project Geologist

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SECTION 1

INTRODUCTION

Packer tests were performed at the EKCO Housewares site in Massillon, Ohio from 15 to 19 April 1991. The packer tests were conducted by Earth Data, Inc. and supervised by Roy F. Weston, Inc. (WESTON). The activities conducted at the site included: geophysical logging, packer testing, groundwater sampling and continuous water level recording. These field activities were conducted as part of an ongoing RCRA Facility Investigation/Corrective Measures Study (RFI/CMS) being conducted at the site.

The objectives of the packer test investigation were to evaluate the:

- vertical profile of groundwater quality and head distributions within the borehole between water bearing units;
- extent of vertical hydraulic interconnection between alternating sandstone and shale beds, and the indicated degree of lateral hydraulic interconnection between the tested wells (R-1 and R-2) and the nearby observation wells (R-4, R-5, I-2 and L-2);
- specific capacities of the primary water-bearing units within each well;
- lateral lithologic correlation of shale and sandstone beds encountered and logged in wells R-1, R-2 and R-4 to better understand the geology and the potential for contaminant migration at the site;
- evaluate the integrity of the casing seal on well R-2.

Packer tests were done on two bedrock monitor wells at the site, designated R-1 and R-2. Prior to performing the packer tests, caliper and gamma ray geophysical logging was done on wells R-1, R-2 and R-4 in order to obtain information necessary for selecting packer intervals and to assist in evaluation of the geology at the site. Water levels were continuously recorded in six wells during the packer testing activities (R-1, R-2, R-4, R-5 I-2 and L-2). The locations of these wells are shown on Figure 1-1.

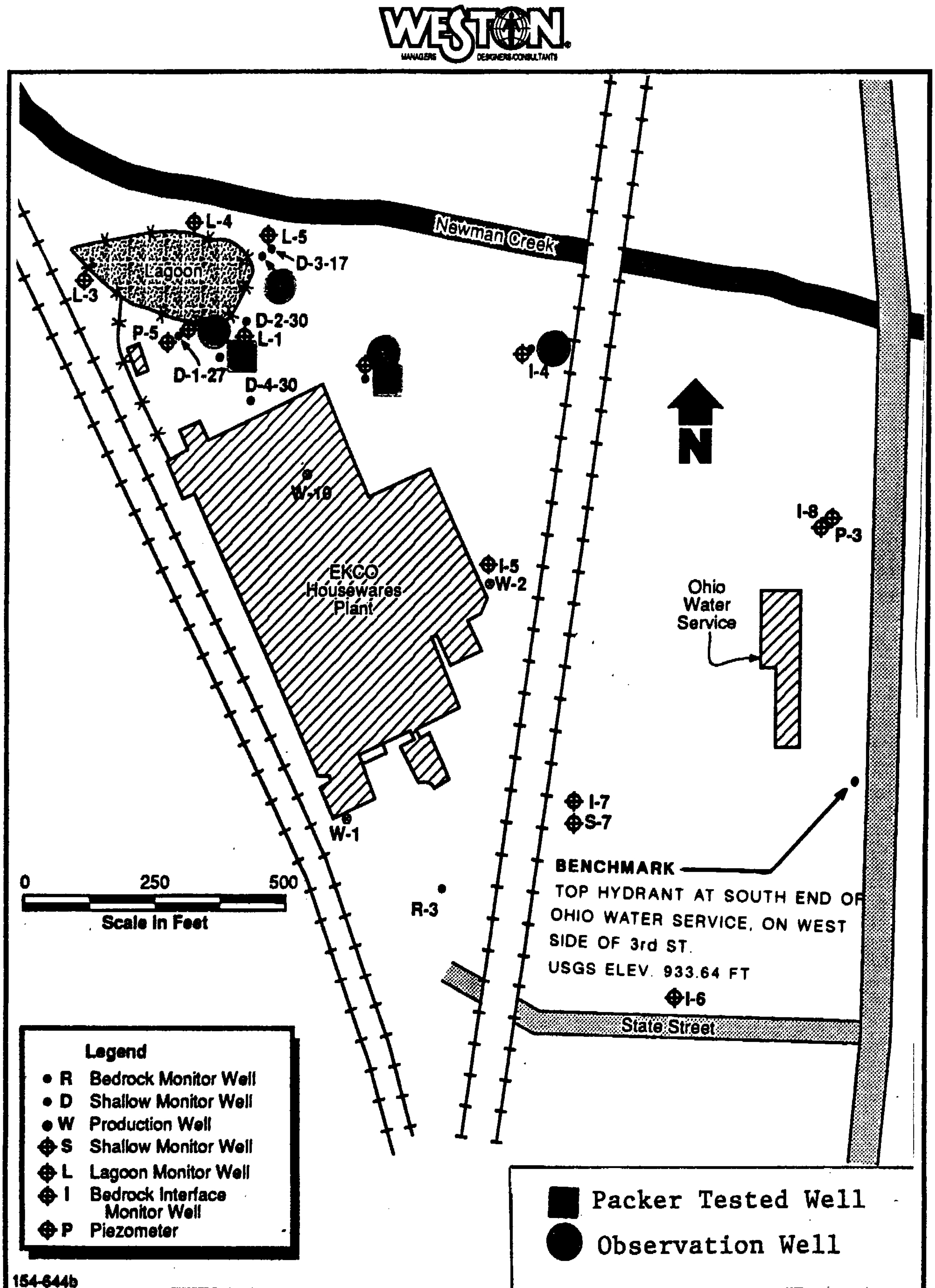


Figure 1-1: Packer Test, Well Location Map, April 1991

The following sections in this report present the methodologies and results of the geophysical logging and the packer tests. The report also presents a discussion of the geology and the hydrogeology at the site, and conclusions based on the results of the packer testing activities. The report is an interim letter report and will be included as part of the final RFI/CMS Report. An in depth discussion on the background information, geology and hydrogeology of the site is presented in the RFI/CMS Work Plan (WESTON, 1990) and the Groundwater Assessment Report (WESTON, 1988).

SECTION 2

GEOPHYSICAL LOGGING

2.1 GEOPHYSICAL LOGGING - OBJECTIVES AND PRINCIPLES

Borehole geophysical logs were run in bedrock wells R-1, R-2 and R-4 at the EKCO site on 15 April 1991, prior to performance of packer testing. The objectives of the logging program were as follows:

1. To identify any problem areas (e.g., obstructions, washouts or fill) in the boreholes which could prevent the setting and removal of the packer tools across the test zones.

2. To identify the presence of smooth borehole sections for the proper seating of the inflatable packers.

3. To correlate the lithology between the three bedrock wells along an east-west cross section.

4. To determine the depth and condition of the casing in each well.

The following suite of geophysical logs was run in wells R-1 and R-2:

- Three Arm Caliper (Caliper)
- Natural Gamma (Gamma)
- Resistivity
- Spontaneous Potential (SP)

All of the above logs were run in well R-4 with the exception of the caliper. No packer testing was to be conducted in this well and only lithologic information was needed.

Each logging run was referenced to the top of the surveyed steel casing at each well so that depths could be converted to feet above mean sea level (MSL). A brief description of each log and the procedures followed in running each log are summarized below.

2.1.1 Caliper Log

The caliper log provides a continuous record of the average diameter, in inches, of a drillhole. Mechanical arms or feelers are maintained against the borehole wall by springs which allow the arms to open and close with changes in borehole size. The caliper tool was run to the bottom of each well, the arms were opened and the log recorded moving up the hole at a constant logging speed of 20 feet per minute (fpm). The caliper log was used to locate smooth or irregular borehole intervals and to check the general condition of each well.

2.1.2 Natural Gamma Log

The gamma log provides a continuous record of the amount of natural gamma radiation emitted by the formations penetrated by a borehole. In general, the natural gamma activity of clay-bearing sediments (i.e., shales) is much higher than that of quartz sands. The gamma ray probe detects gamma radiation through the use of a sodium iodide crystal and scintillation counter. The greater the counting rate, the more events the gamma detector is measuring, which, in turn, corresponds to a higher clay content of the surrounding strata. The natural gamma log does not have a unique response to lithology, however, response is generally consistent within a single geohydrologic environment. The gamma tool was run recording from the bottom to the top of each well at a constant logging speed of 20 fpm. The gamma logs were used to identify the various lithologic units beneath the site where the relative gamma response decreased from the fine-grained shales or siltstones to the coarse-grained sandstones.

2.1.3 Resistivity Log

The resistance log measures the electrical resistance (in ohms) of the earth materials lying between two electrodes in the well. Increases in formation resistance produce corresponding increases in resistance on the log. In general, the resistance log response in resistive rocks (sandstones) and conductive rocks (shales) provides a mirror image of the gamma log under suitable conditions. Because a constant electric current is generated between the two in-hole electrodes on the resistance tool, the log requires a borehole fluid to conduct the current. As a result, the resistance tool was run from the bottom to the top of the fluid column in each well at a constant logging speed of 20 fpm. The resistance logs were used to correlate lithologic changes and shale content in the uncased, fluid-filled portions of each well.

2.1.4 Spontaneous Potential Log

The spontaneous potential log is a record of potentials or voltages that develop between shale and sandstone contacts when salinity differences exist between the borehole fluid and the formation water. These logs are widely used in the oil fields to provide information on lithology and salinity of interstitial water, but are not universally applicable in fresh-water environments. Salinity differences did not exist in the EKCO wells and, therefore, no interpretation was made of the SP logs. The log was part of the combination electric tool which housed the resistance log described previously.

2.2 GEOPHYSICAL LOGGING - RESULTS

The results of geophysical logging in wells R-1, R-2 and R-4 revealed three important characteristics about the geology and hydrogeology beneath the EKCO site.

1. A fairly thick (approximately 40 feet), relatively permeable and laterally continuous sandstone exists in each well which, in packer tests, contributed over 90 percent of the total yield in wells R-1 and R-2.

2. Overlying the productive sandstone in wells R-1 and R-2 is an alternating sequence of low permeability shales and argillaceous sandstones which collectively serve to confine and separate the underlying sandstone from the unconsolidated glacial deposits above.

3. Erosion of the bedrock surface (during Quaternary glaciation) effectively removed the low permeability shales and argillaceous sandstones in the vicinity of well R-4. As a result, the productive sandstone in well R-4 is directly overlain by a thick sequence (approximately 89 feet) of unconsolidated glacial outwash deposits.

Figure 2 shows an interpretive geologic cross-section of the stratigraphic units penetrated by wells R-1, R-2 and R-4. The cross-section is based primarily on the results of the geophysical logs, driller's logs and regional data from the U.S. Geological Survey (USGS). Copies of the geophysical logs from wells R-1, R-2 and R-4 are provided in Appendix A.

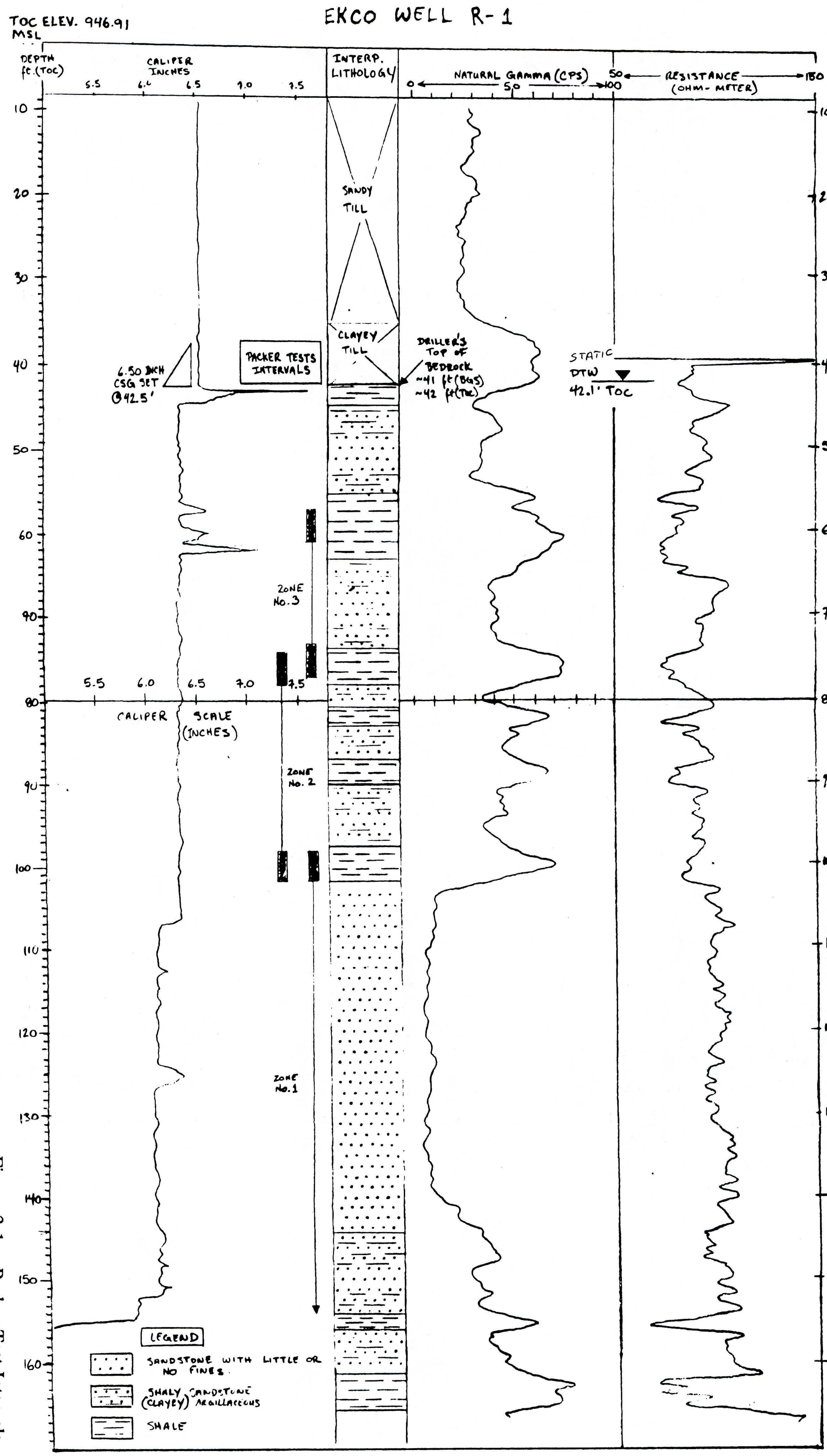


Figure 3-1: Packer Test Intervals, Geological and Geophysical Logs for Monitor Well R-1

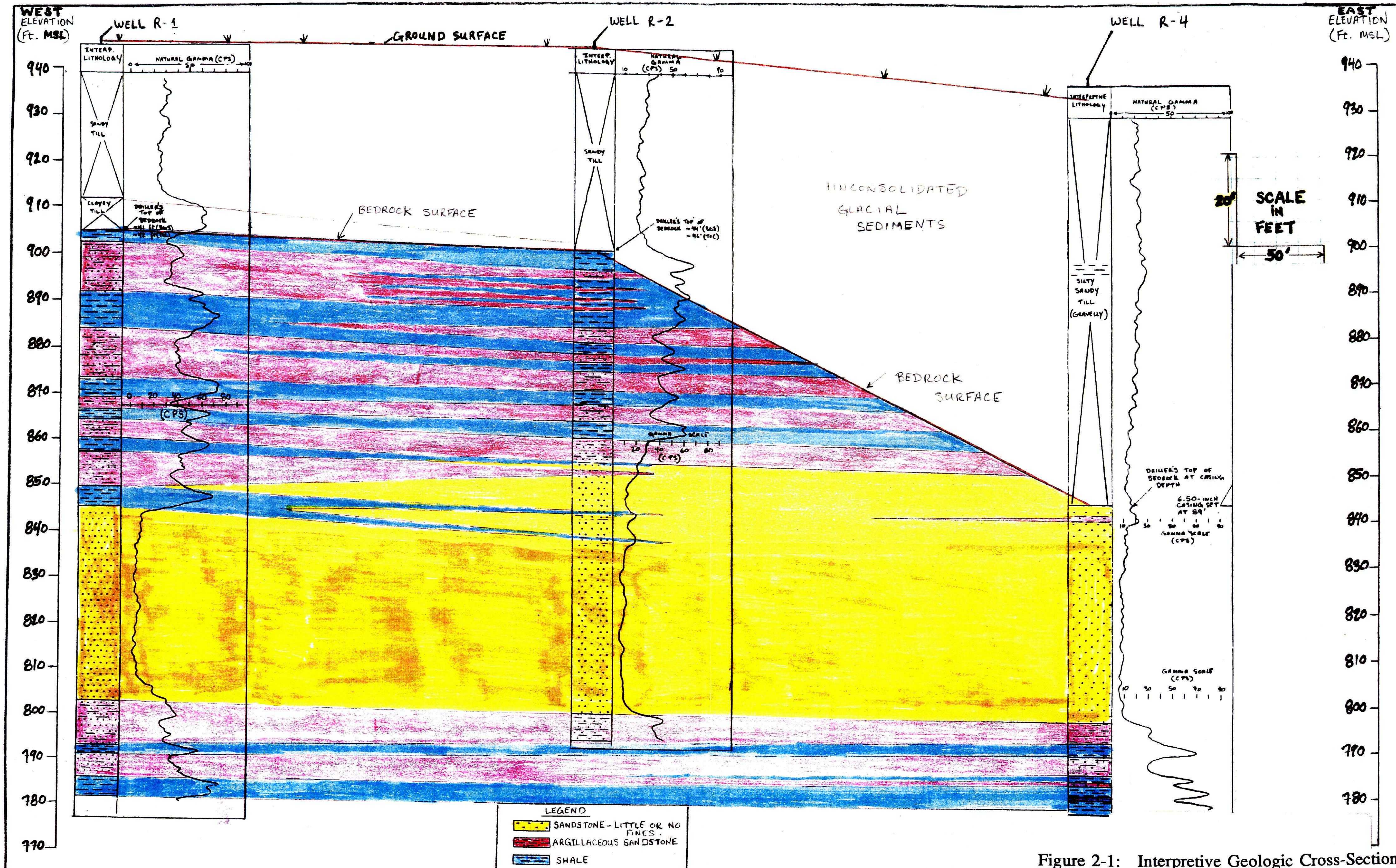


Figure 2-1: Interpretive Geologic Cross-Section

SECTION 3

PACKER TESTING

3.1 PACKER TESTING METHODOLOGY

In order to evaluate the vertical profile of volatile organic compound (VOC) contamination of groundwater in the bedrock beneath the site, a total of five straddle packer tests were performed on bedrock wells R-1 and R-2. The test intervals were based on the geophysical logging results. The specific protocol for the straddle packer tests was as follows:

1. Decontaminate the packers and all downhole equipment following procedures presented in the Work Plan (WESTON, 1990)

2. Conduct geophysical logging of the well with caliper, gamma, and resistivity logs.

3. Prior to testing each zone, obtain static water levels and calibrate the pressure transducers to these static levels (T.O.C.).

4. Lower the packer tool configuration to the deepest test zone and calibrate all transducers to the static water level (referenced to top of casing) prior to inflation of the packer(s).

5. Inflate the packer(s) and allow each isolated portion of the borehole to stabilize. Double-check each pressure transducer and record the head values above, between, and below the packers.

6. Begin pumping of the test zone. Maintain a constant pump rate that will adequately stress the test zone (without dewatering the zone), and record changes in head in the test zone and in the isolated borehole above and below the packers. The objective is to obtain a stable drawdown (plus or minus 0.5 ft) that can be maintained over a 30-minute period with constant rate pumping. Estimated specific capacity values by dividing pumping rates by the indicated drawdowns (gpm/ft).

7. Obtain analytical samples once a stable drawdown has been obtained and general water quality parameters have stabilized, and again just prior to termination of pumping. At least five test interval volumes were pumped between each sample collection.

8. Stop the pumping phase of the test and close the flow control valve to prevent water in the purge line from reversing back down the hole. Monitor the recovery of head values until at least 90 percent recovery is obtained.

9. End the test and deflate the packers.

Due to the low yield of two of the test zones (R-1/Zone 2 and R-1/Zone 3), it was not feasible to purge five volumes between the first and second samples, and in test R-2/Zone 2, only one sample was taken at the conclusion of the test.

3.2 PACKER TESTING RESULTS

Five packer tests were conducted at the EKCO site, three on Well R-1 and two on Well R-2. A falling head casing seal test was also conducted on Well R-2. The pumping times of the five tests ranged from 100 to 180 minutes, and the maximum pumping rates ranged from 0.2 to 24 gallons per minute (gpm), depending on the yielding capacity of the tested zone. The specific capacities were calculated for each test zone and ranged from 0.0069 to 1.82 gpm/ft. A summary of the packer test results are shown in Table 3-1. The packer test zones were numbered from the bottom to the top of the wells. During the Zone 1 test in both wells (R-1 and R-2), the bottom packer was left uninflated in order to evaluate the entire bottom portion of the well, from the upper packer depth to the total depth of the well.

Groundwater samples were collected from each tested zone and analyzed for VOCs in order to evaluate the vertical profile of VOC contamination in the bedrock groundwater. During all but one of the tests (R-2/Zone 2), two time series samples were collected to evaluate how the VOC concentrations changed as pumping progressed. The total VOC concentrations ranged from 227 parts per billion (R-1/Zone 1) to 1,100 parts per billion (R-2/Zone 2). The lowest VOC concentration was found in the deepest zones in both Wells R-1 and R-2. A summary of the packer test groundwater sampling results is shown in Table 3-2.

TABLE 3-1

PACKER TEST ACTIVITIES SUMMARY TABLE

Well/Zone	Test Date	Time Start Pump	Time Stop Pump	Total Pump Time (min)	Max Q (gpm)	Specific Capacity (gpm/ft)	Packer Spacing	Depth to Water Before Packer Inflation	Depth to Water After Packer Inflation (ft)		
									Above Upper Packer	Between Packers	Below Lower Packer
R-1/Z-1	4/16/91	11:05	12:45	100	24	1.82	102-TD (165)	42.80	42.74	49.40	NI
R-1/Z-2	4/17/91	16:15	19:15	180	0.3	0.0069	78.8-98.0	43.21	43.04	40.33	50.05
R-1/Z-3	4/16/91	15:40	17:30	110	0.8	0.06	61.6-73.6	43.03	42.12	43.08	48.55
R-2/Z-1	4/18/91	13:10	14:50	100	22	1.80	87.8-TD (150)	30.05	28.43	48.85	NI
R-2/Z-2	4/18/91	17:07	19:30	143	0.2	0.0087	63.6-84.0	31.32	27.95	33.02	48.79

NI - lower packer not inflated

AHP-2/PACKR3-1.TBL

TABLE 3-2

PACKER TEST GROUNDWATER SAMPLING RESULTS

Well/Zone	Total Time of Test (min)	Total Well Volumes Purged	Sample	Sample Date	Sample Time	Test Time of Sample (min)	Volumes Purged When Sampled	Total VOCs (ppb)
R1/Z1	100	18.0	A	4/16/91	12:20	75	12.5	**227**
			B	4/16/91	12:45	100	18.0	**248**
R1/Z2	240	1.5	A	4/17/91	18:15	120	1.0	**506**
			B	4/17/91	19:15	180	1.5	**496**
R1/Z3	110	4.0	A	4/16/91	16:30	50	2.5	**297**
			B	4/16/91	17:30	110	4.0	**348**
R2/Z1	100	18.5	A	4/18/91	14:15	65	12.0	**872**
			B	4/18/91	14:45	95	18.5	**769**
R2/Z2	143	1.7	A	4/18/91	19:30	143	1.7	**1,100**
			B	NS	NS	NS	NS	**NS**
R2/Hydrant*	NA	NA	NA	4/19/91	9:30	NA	NA	**6**

* - Sample of the fire hydrant water which was used for the falling head test.
NS - The second sample (Sample B) was not collected during this test due to the low yield of the well.
NA - Not applicable; referenced sample was taken from a falling head test and no water was purged from the well.

AHP-2/PACKR3-2.TBL

3.2.1 Well R-1

The packer test spacing intervals for both wells (R-1 and R-2) were plotted along side the geologic and geophysical logs, in order to display the lithologies that were tested. Figure 3-1 shows the packer test intervals for Well R-1. The upper packer in Zone 1 was seated in a 4-foot thick shale layer from 98 to 102 feet below ground surface (bgs), and the lower packer was left uninflated. Directly underlying the shale layer in Zone 1 is 42 feet of sandstone with apparently very little or no fine material. Below the sandstone is approximately 21 feet of alternating layers of argillaceous sandstone and shale. Zone 2 was located directly above Zone 1 and straddled 20 feet of argillaceous sandstone and shale from 78.8 to 98.0 feet bgs. Zone 3 was located directly above Zone 2 and straddled 12 feet of argillaceous sandstone from 61.6 to 73.6 feet bgs.

Water levels were continuously measured in the tested well during each packer test at three locations in the borehole; above the upper packer, between the two packers and below the lower packer. As can be seen in Table 1, there was a significant downward gradient from above the upper packer to between the packers and from between the packers to below the lower packer in every test except one (R-1/Zone 2). In test R-1/Zone 2, there was a downward gradient from between the packers to below the bottom packers, but there was an upward gradient from between the packers to above the upper packer. The static water level below the upper packer was significantly higher than the top of the overlying shale bed for all five of the tested zones indicating that they were all under confined conditions. Water levels were also continuously measured during each test in the five observation wells (I-2, L-2, R-4 and R-1/R-2). Time-drawdown graphs were plotted for all of the tests and are discussed below.

The time-drawdown graph for Well R-1 during the Zone 1 packer test is shown in Figure 3-2. The flow rate was stepped up four times to a maximum rate of 24 gpm. The water level below the upper packer in Zone 1 was lowered 13.2 feet during the drawdown and fully recovered when the pump was shut off. The water level above the packer did not change during the test indicating that the packer seal was not leaking and that the overlying shale acted as a barrier to groundwater flow during the test. Figure 3-3 shows the time-drawdown graphs for the five observation wells monitored during the Zone 1 test. The time when the pump in Well R-1 was turned on and off is indicated on each graph. As can be seen in Figure 3-3, no significant drawdown occurred in any of the observation wells during the test.

The productive sandstone unit which exists in the three wells is indicated on the logs by low gamma response (approximately 10 counts per second [cps]) and correspondingly high electrical resistance. The low gamma activity implies a low percentage of fine-grained materials in the matrix of this sandstone member, which accounts for its relatively permeable nature. The overlying argillaceous sandstones in wells R-1 and R-2, indicated on the logs by relatively moderate gamma response (30-50 cps), implies the presence of interstitial clay or silts which reduce the permeability of water-bearing geologic deposits.

The shale beds in wells R-1 and R-2 are indicated on the logs by relatively high gamma response (50-70 cps) and correspondingly low electrical resistance. Shales are by definition low in permeability unless secondary fracturing has occurred. The sedimentary rocks in the region of the site have not undergone any appreciable deformation and, in fact, dip only slightly to the southeast (USGS).

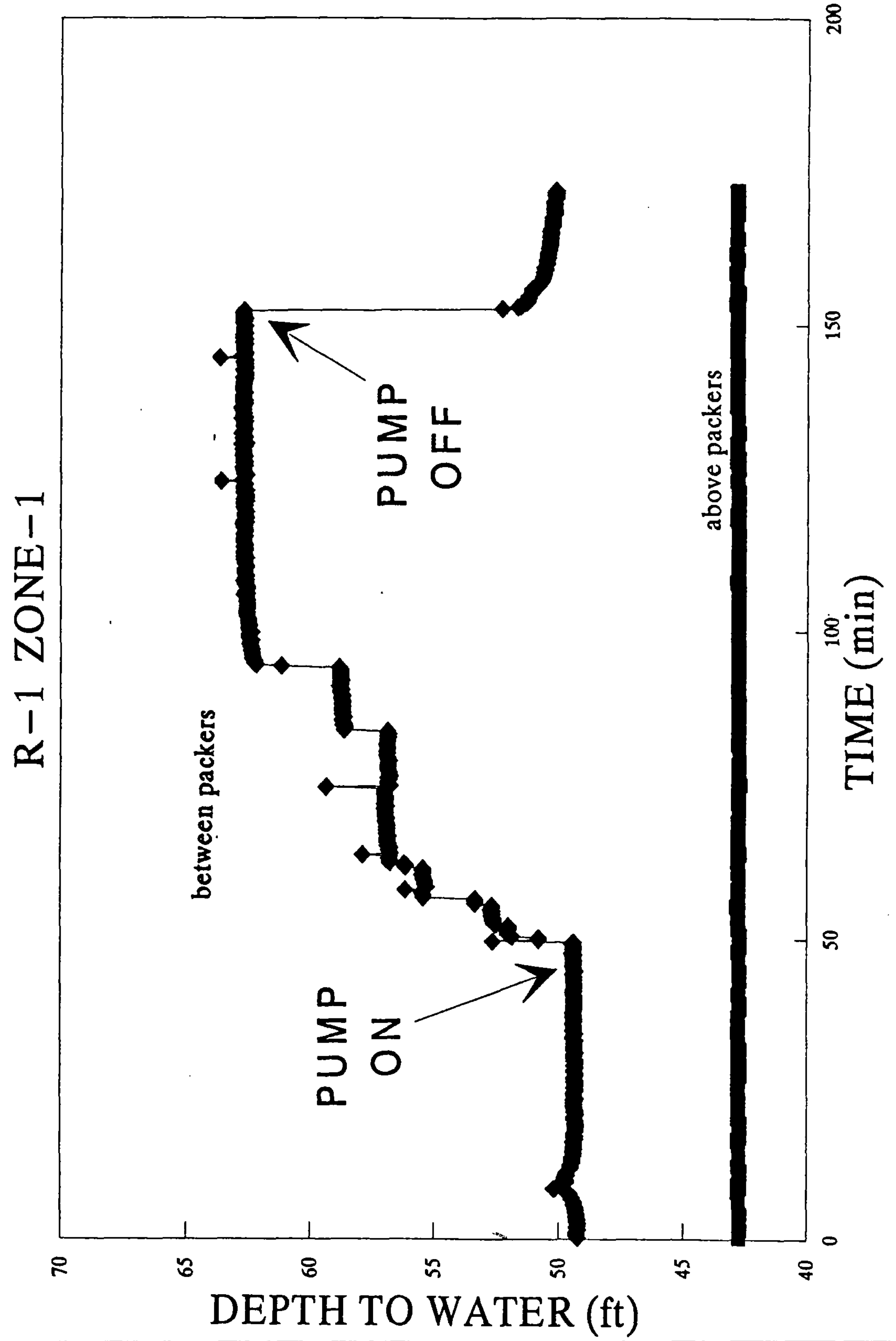


Figure 3-2: Water Level Drawdown Curves for the Pumping Well for Test R-1, Zone-1

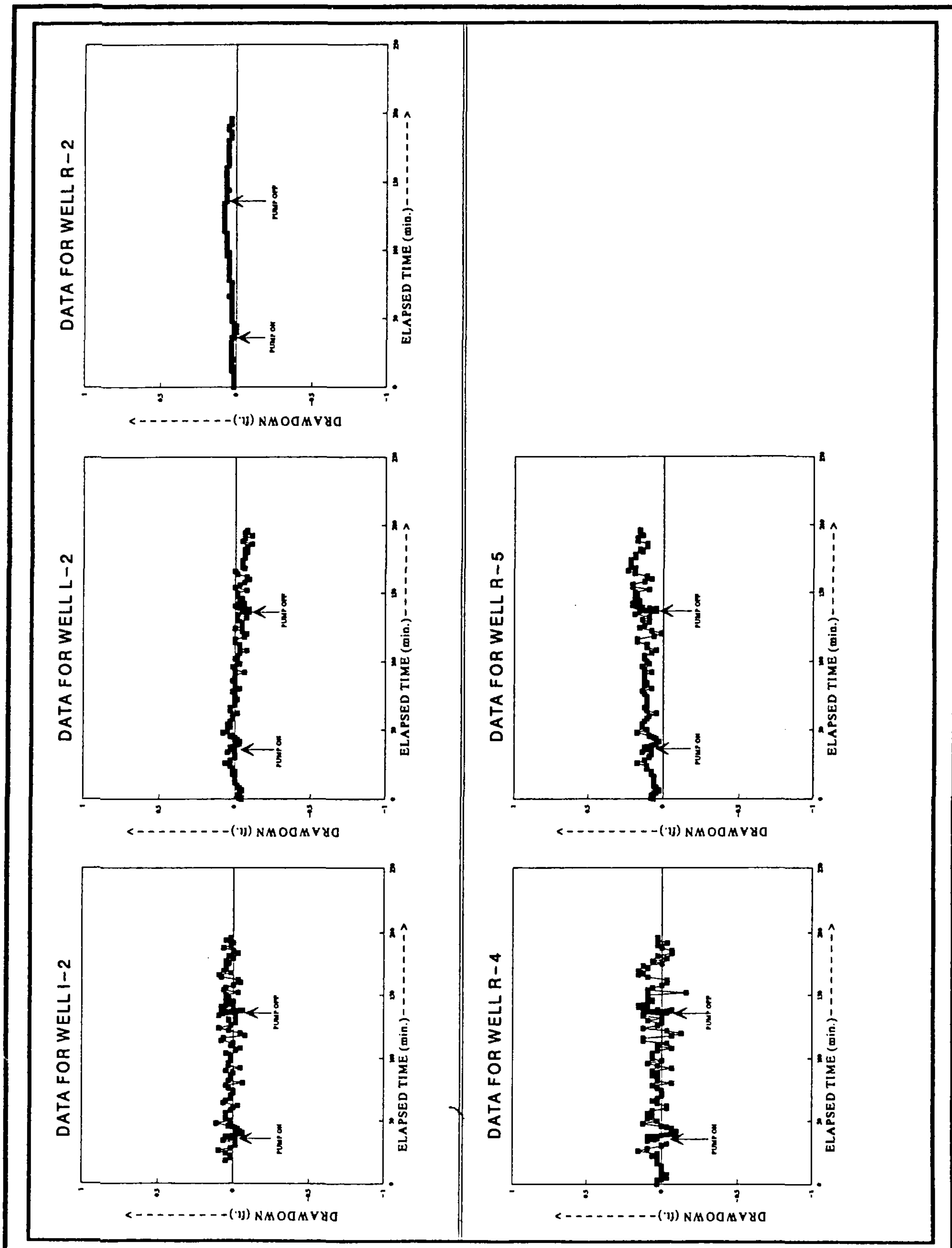


Figure 3-3: Water Level Drawdown Curves for the Observation Wells for Test R-1, Zone-1

The time-drawdown graph for Well R-1, test Zone 2 is shown in Figure 3-4. The flow rate was adjusted to a maximum rate of 0.3 gpm. Some minor fluctuations occurred in the pumping rate and the drawdown. The sudden drawdown indicated on Figure 3-4 at approximately 30 minutes was caused by a leaking check valve which was repaired and the test resumed at approximately 50 minutes. The water level between the packers was lowered 50 feet during the drawdown test then fully recovered when the pump was shut off. The water levels above the upper packer and below the lower packer did not change during the test. The time-drawdown graphs for the Zone 2 observation wells on Figure 3-5 show that none of the wells were affected by the pumping of Zone 2. Figure 3-6 shows the time drawdown graph for Well R-1 test Zone 3. The water level between the packers was lowered 14 feet during the drawdown test, then fully recovered when the pump was shut off. The water level above the upper packer did not change during the test, but the water level below the lower packer was lowered approximately one foot when the pump was turned on then quickly leveled off. This may have been due to an initial leak around the packer or minimal groundwater movement through the lower shale layer. The time-drawdown graphs for the Zone 3 observation wells on Figure 3-7 show that none of the wells were affected by the pumping of Zone 3.

3.2.2 Well R-2

Two zones were packer tested in Well R-2. The packer test intervals, along with the geological and geophysical logs, are shown in Figure 3-8. The upper packer in Zone 1 was seated in a 4-foot thick shale bed from 83 to 87.8 feet bgs and the lower packer was left uninflated. Directly underlying the shale layer in Zone 1 is 58 feet of sandstone with very little or no fine material. Below the sandstone is approximately 10 feet of silty shale. Zone 2 was located directly above Zone 1 and straddled 20 feet of shaley sandstone and shale from 63.6 to 84.0 feet bgs. In addition to the two packer tests, a falling head test was conducted at the casing bottom/bedrock interface to determine the integrity of the casing seal.

Figure 3-9 shows the time-drawdown graph for R-2/Zone 1. The water level below the upper packer was drawn down 12.2 feet during the drawdown test and fully recovered when the pump was shut off. The water level above the packer did not change during the test. The time drawdown graphs for Zone 1 observation wells on Figure 3-10 show that the water level in R-4 was drawn down approximately 0.2 feet and then fully recovered when the pump was shut off. None of the other observation wells were affected by the pumping of Well R-2. Figure 3-11 shows the time-drawdown graph for R-2 Zone 2. The water level between the packers was lowered 23 feet during the drawdown test and fully recovered when the pump was shut off, and the water levels above and below the packers did not change during the test. The time-drawdown graphs for the five observation wells on Figure 3-12 show that none of the wells were affected by the pumping of R-2/Zone 2.

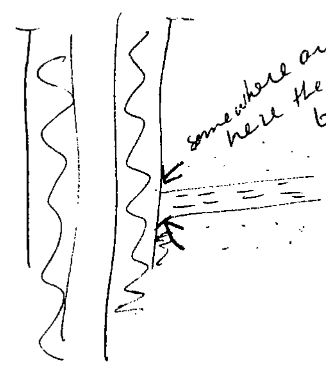
A falling head casing seal test was conducted by inflating the top packer 2 feet below the bottom of the casing and sealing off the upper 2 feet of the borehole from the rest of the well (Figure 3-8). The 2-foot zone which was left open consisted entirely of a relatively low permeability shale. The well was filled up to the surface with potable water and the water level in the well was monitored. If there was a proper casing seal in place, the water level in the well should have remained relatively constant; however, after the casing was filled to the surface, the water level quickly dropped back to static conditions. The water recharged much more rapidly than would be reasonable considering the relatively limited permeability of the exposed 2-foot thick shale interval. The hydraulic conductivity was calculated from the falling head data using the Bouwer and Rice falling head test method (Bouwer and Rice, 1976) to be 6.29 ft/day. This value is within the range for an unconsolidated sand material (Cherry, 1979), and several orders of magnitude higher than would be expected for the 2-foot shale interval which was isolated during the test. This implies that the water leaked around the casing and into the highly permeable unconsolidated material above. The falling head test data is included in Appendix B, and copies of the drillers logs for wells R-1 through R-4 are included in Appendix C.

Three other bedrock monitoring wells R-1, R-3 and R-4 were installed at the same time as well R-2, using the same driller and drilling method. This suggests the possibility that the casing seal between the bedrock and the unconsolidated sediments in those wells may also be leaking. Wells R-3 and R-4 are a minor concern since the levels of contamination are low (90 ppb and 1.75 ppb, respectively). In addition, at well R-3 the top of bedrock is so near to the ground surface that the unconsolidated sediments are dry; therefore there is little potential for groundwater to readily migrate from the unconsolidated sediments to the bedrock aquifer. Also, at well R-4, the low permeability shale has been eroded away and the unconsolidated sediments are in direct contact with the high permeable sandstone aquifer (Figure 2-1). This geology allows for the groundwater in the unconsolidated sediments to migrate easily downward into the sandstone bedrock aquifer along the bedrock interface regardless of the integrity of the casing seal.

EKCO needs to remediate these wells immediately

However, the conditions at well R-1 are similar to those at well R-2. The total VOC concentration is relatively high (1,440 ppb) and there is 60-feet of shale and argillaceous sandstone overlying the high permeable sandstone aquifer which would naturally limit downward migration of contaminated groundwater from the unconsolidated sediments to the deeper sandstone aquifer. But, if the casing seal in well R-1 is leaking as in well R-2 it would induce downward migration of contaminated groundwater along the borehole to the sandstone bedrock aquifer.

It is a possibility that the casing seal leak in well R-2 is partially due to natural fracturing in the shale bedrock. One method to prevent the casing seal from leaking under these conditions is to install a 4-inch screened well in an 8-inch borehole. The well screen and sandpack should be installed in the sandstone aquifer, overlain by a bentonite seal and grouted to the surface. This method insures an excellent seal around the well at the bedrock interface, and will eliminate the potential for groundwater to migrate from one aquifer to another along the borehole. — would not do any good.



somewhere around here the seal is broken need to either plug & abandon or perforate the casing & cement behind it.

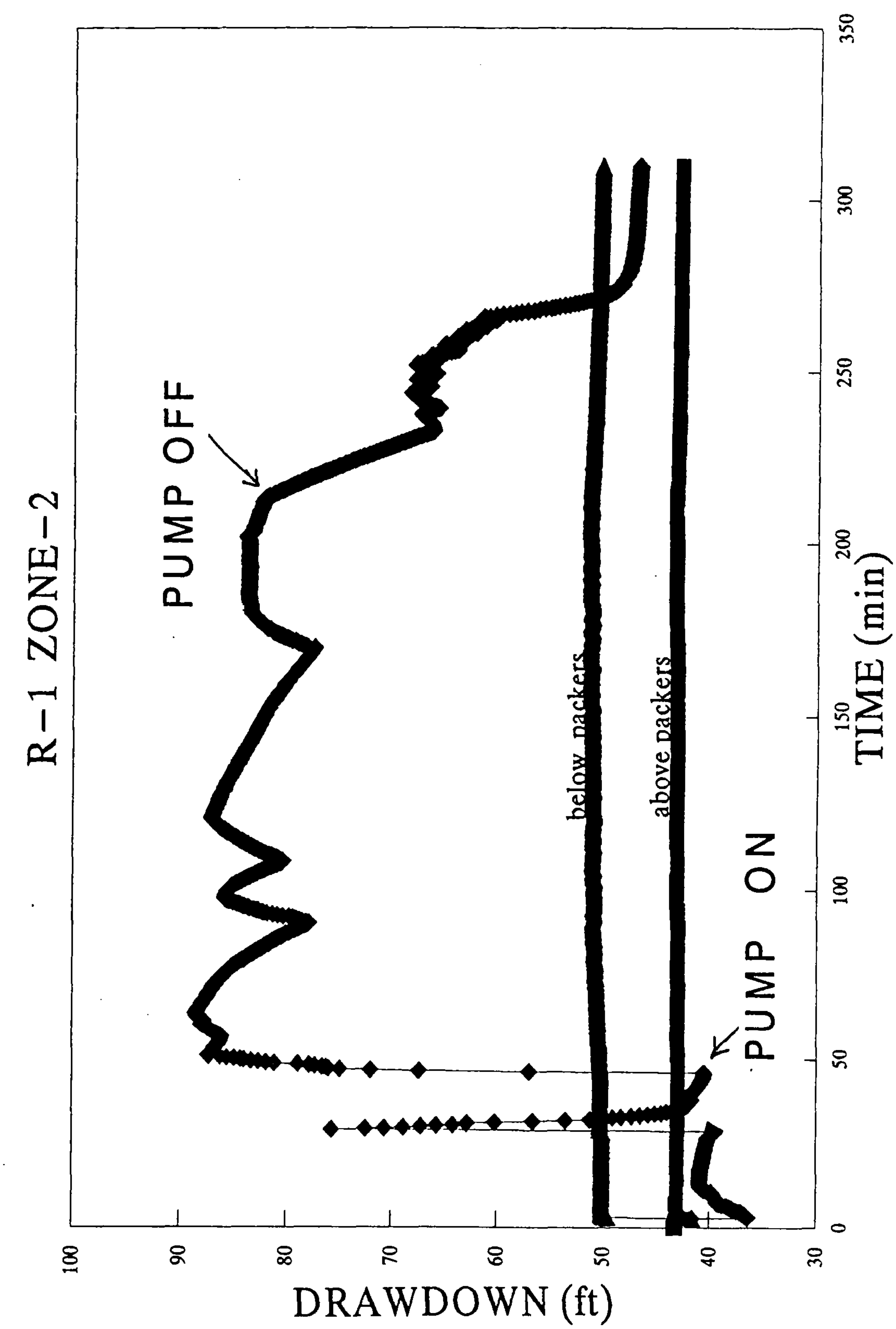


Figure 3-4: Water Level Drawdown Curves for the Pumping Well for Test R-1, Zone-2

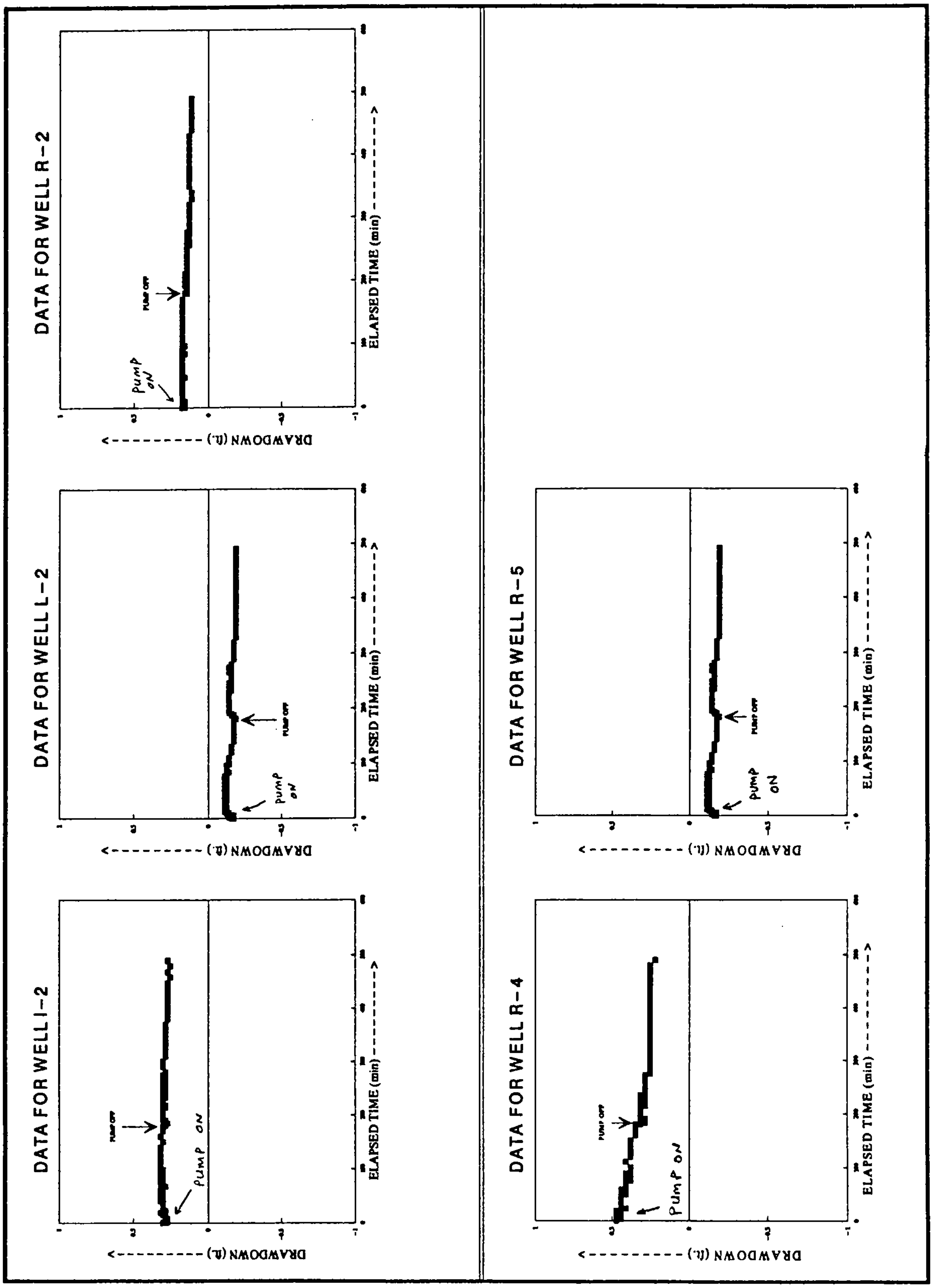


Figure 3-5: Water Level Drawdown Curves for the Observation Wells for test R-1, Zone-2

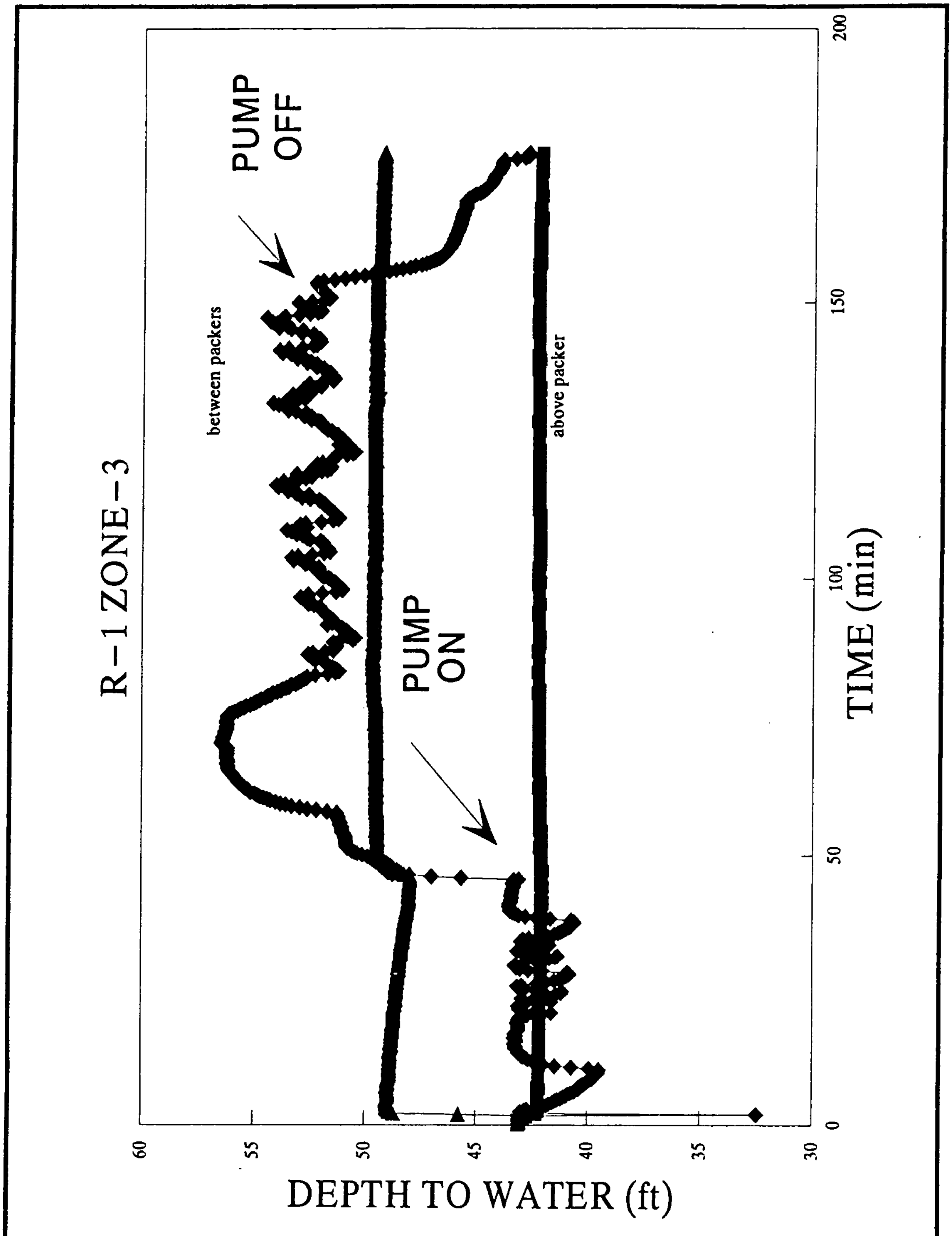


Figure 3-6: Water Level Drawdown Curves for the Pumping Well for Test R-1, Zone-3

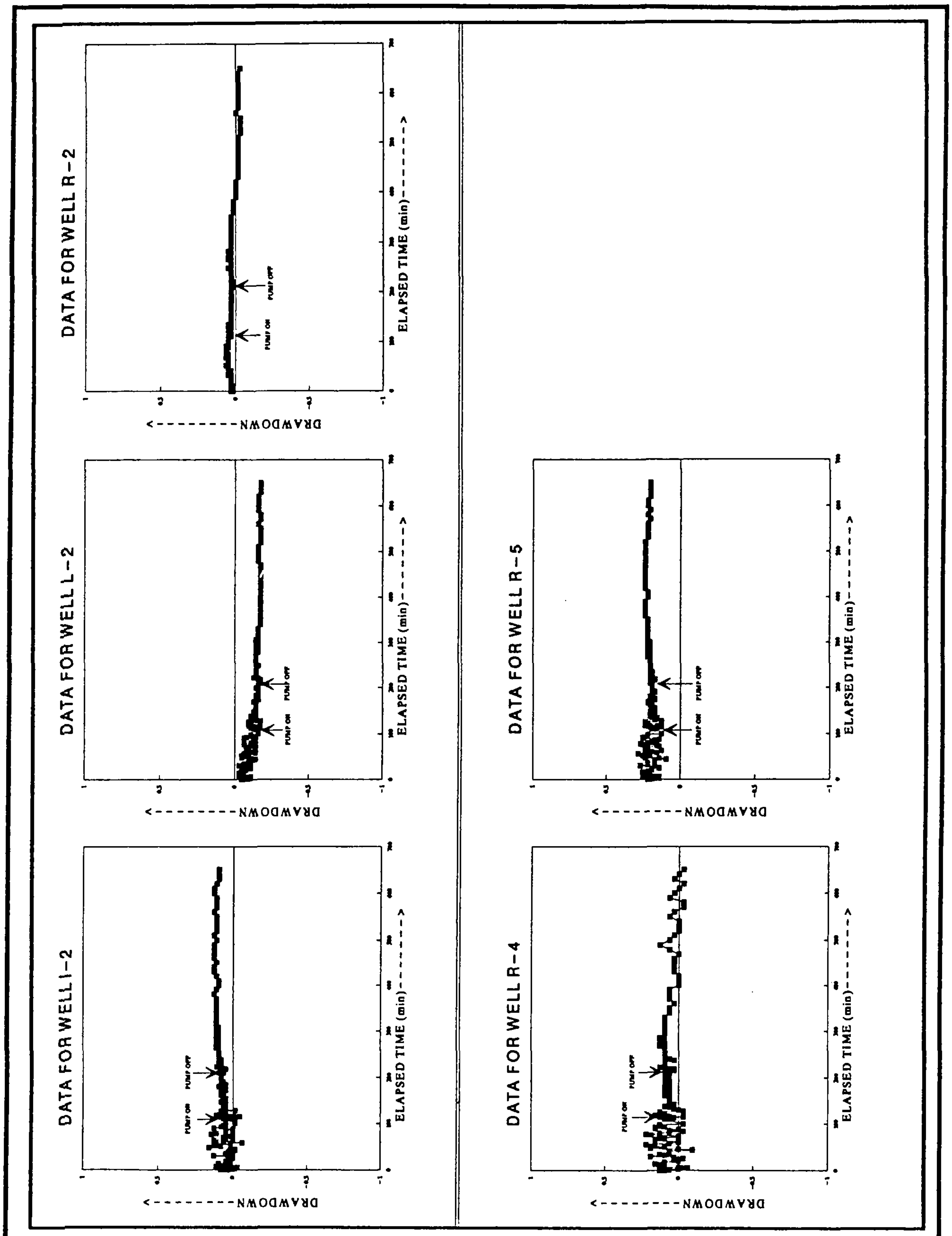


Figure 3-7: Water Level Drawdown Curves for the Observation Wells for Test R-1, Zone-3

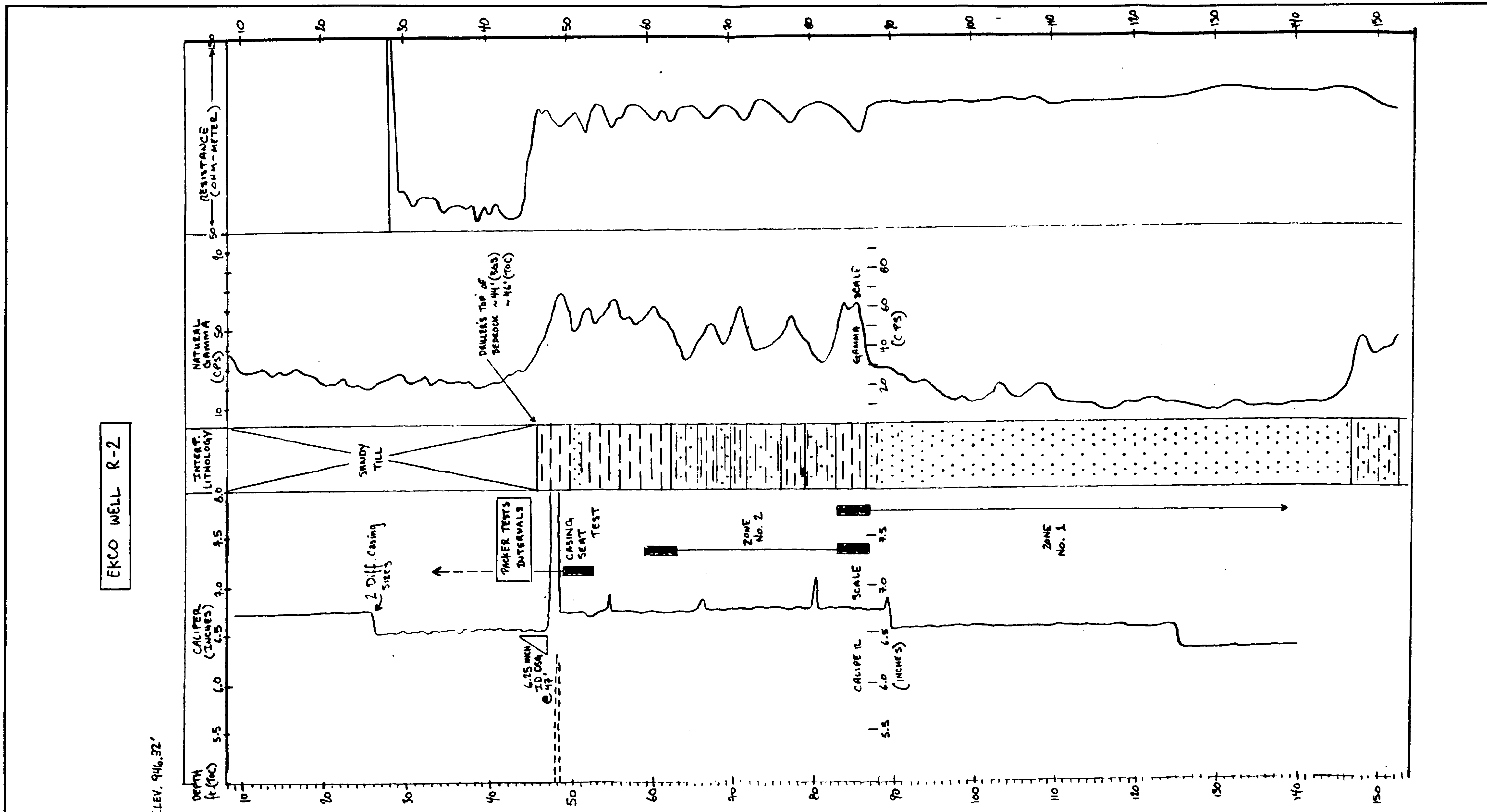


Figure 3-8: Packer Test Intervals, Geological and Geophysical Logs for Monitor Well R-2

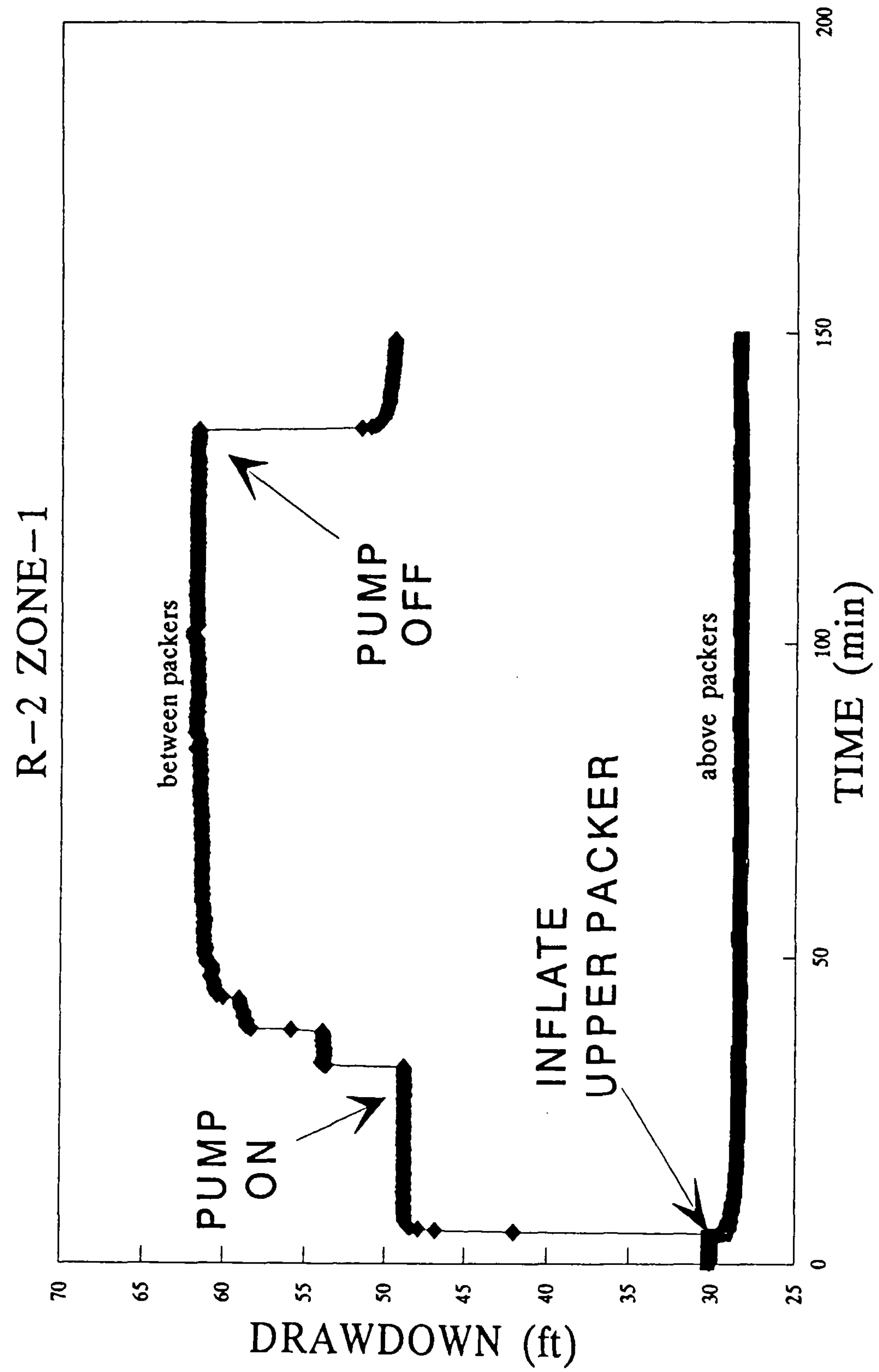


Figure 3-9: Water Level Drawdown Curves for the Pumping Well for Test R-2, Zone-1

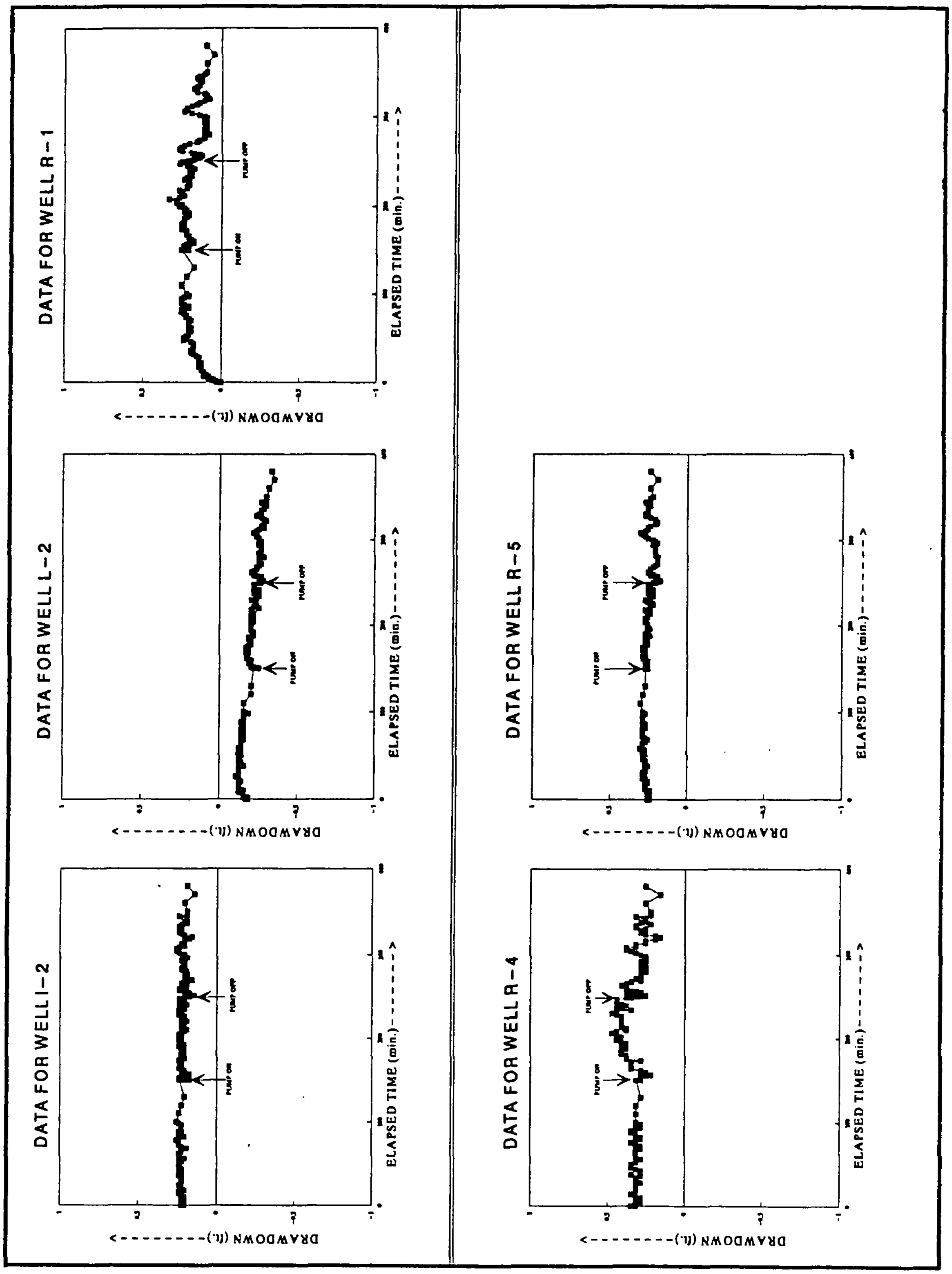


Figure 3-10: Water Level Drawdown Curves for the Observation Wells for Test R-2, Zone-1

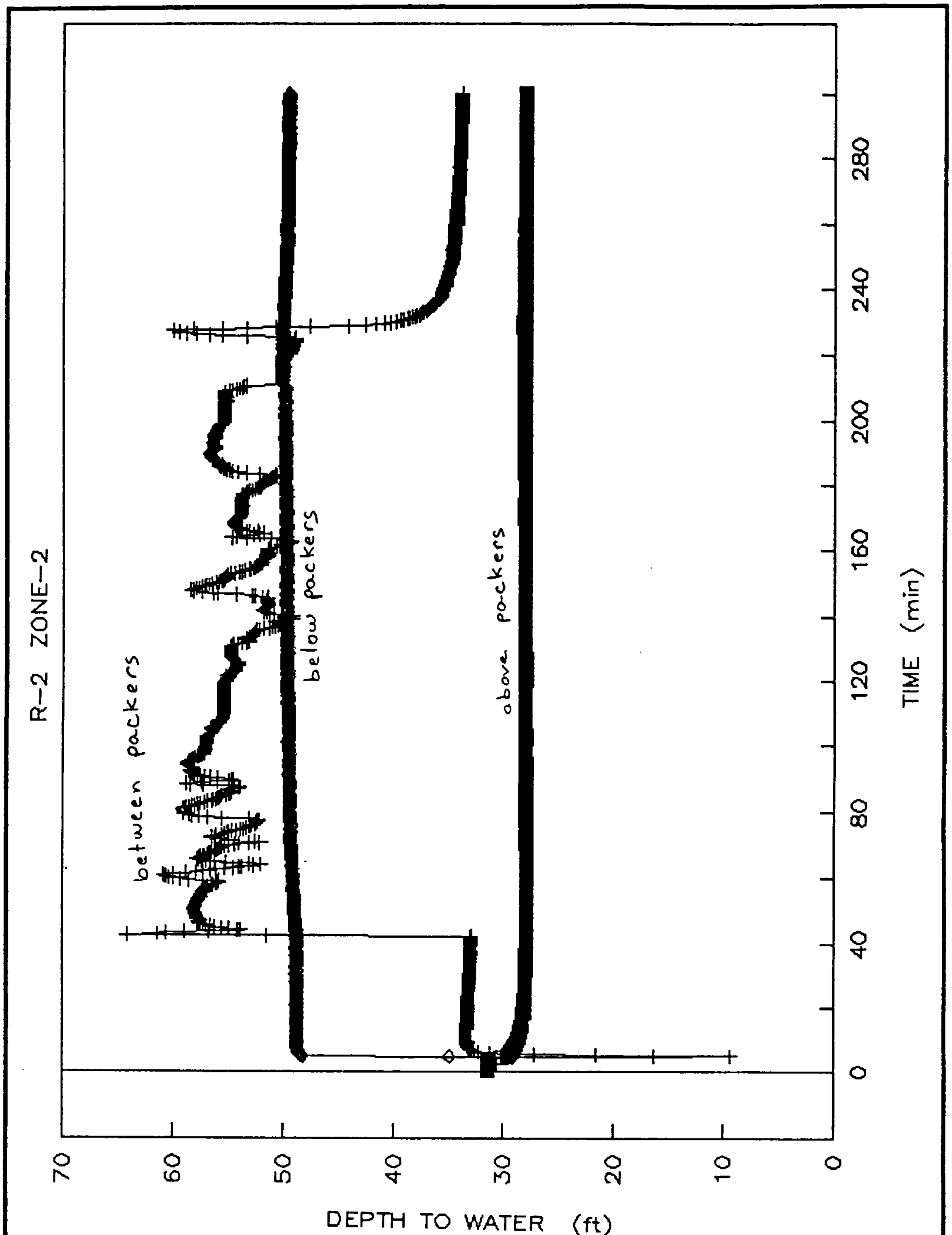


Figure 3-11: Water Level Drawdown Curves for the Pumping Well for Test R-2, Zone-2

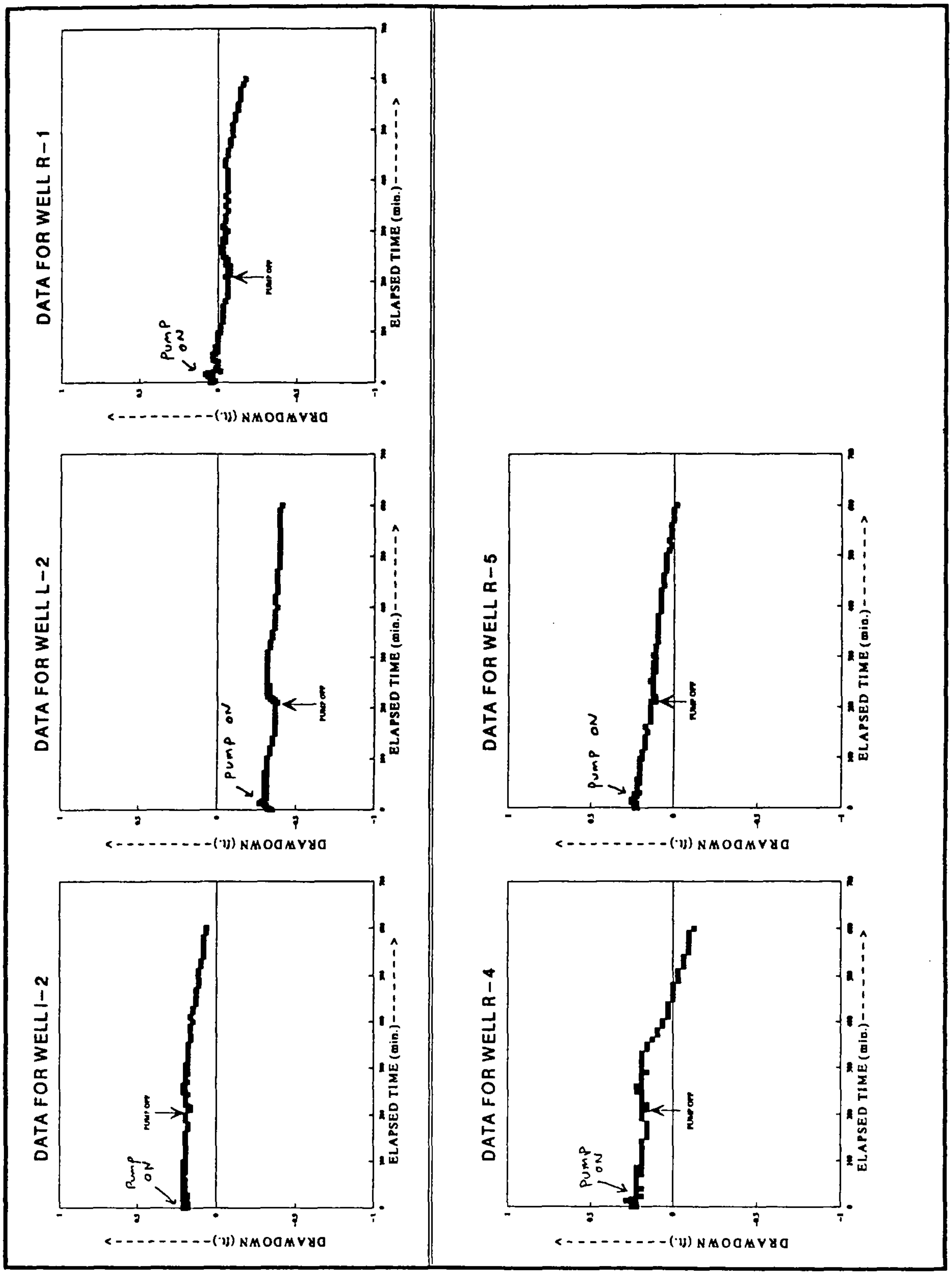


Figure 3-12: Water Level Drawdown Curves for the Observation Wells for Test R-2, Zone-2

SECTION 4

CONCLUSIONS

The following conclusions are based on the results of the packer testing and geophysical logging activities done at the site:

- A fairly thick (approximately 40 feet) permeable and laterally continuous sandstone exists in each well which, in packer tests, contributed over 90 percent of the total yield in wells R-1 and R-2.

- Overlying the productive sandstone in wells R-1 and R-2 is an alternating sequence of low permeability shales and argillaceous sandstones which collectively serve to confine and separate the underlying sandstone from the unconsolidated glacial deposits above.

- VOCs were detected in all 5 zones tested with concentrations ranging from 227 to 1,100 ppb.

- Packer test sampling results from Wells R-1 and R-2 indicated that VOC concentrations are lower in the deeper, productive sandstone than in the overlying shallower shales and argillaceous sandstones.

- Static water level data from the zones tested during the packer tests indicated that a downward vertical gradient exists in Wells R-1 and R-2.

- The falling head casing seal test results indicated that the casing seal is leaking in Well R-2.

- Erosion of the bedrock surface (during Quaternary glaciation) effectively removed the low permeability shales and argillaceous sandstones in the vicinity of well R-4. As a result, the productive sandstone in well R-4 is directly overlain by a thick sequence (approximately 89 feet) of unconsolidated glacial outwash deposits.

REFERENCES

Bouwer, H., Rice, R.C., 1976. A slug test for determining conductivity of unconfined aquifers with completely or partially penetrating wells. Water Resources Research, Vol. 12, Vo.3.

Freeze, R.A., Cherry, J.A., 1979. Groundwater Prenhce Hall Inc., Englewood Cliffs, NJ.

Roy F. Weston, Inc., May 1990 - RFI/CMS Work Plan for EKCO Housewares, Inc., Massillan, Ohio.

APPENDIX A

GEOPHYSICAL LOGS

WESTON

EARTH DATA INCORPORTATED

St. Michaels, Maryland & Exton, Pennsylvania

PHONE NUMBER: 301-745-5046

GEOPHYSICAL WELL LOG:	PERMANENT DATUM: Mean Sea Level	OTHER SERVICES:
SELF-POTENTIAL NATURAL GAMMA SINGLE POINT RESISTANCE	LOG MEASURED FROM: TOP OF CASING ELEVATION 946.91 Feet above MSL	

EDI JOB NO: 901
WELL: R-1
LOCATION: MASSILLON, OHIO

COMPANY: R.F. WESTON
PROJECT: ECKO SITE
WELL IDENTIFICATION: R-1

STATE: OHIO
COUNTY: STARK

COORDINATES:
N:
E:
ELEVATION: KB:
DF:
GL:

	Run No. 1		Run No. 1
Date	04/15/91	Fluid Level	
Bottom logged Int.	0'	Fluid Nature	WATER
Top Logged Int.	167'	Fluid Viscosity	
Footage Logged	167'	Fl. Resistivity	
Bottom (Driller)	170'	Fl. Res. at BHT	
Casing (from Log)		Fluid pH	
Casing (Driller)	42'	Circulation Temp	
Casing Size		Bottom Hole Temp	
Bit Size			
		LOGGED BY:	MICHAEL LEDWITH
		WITNESSED BY:	PAUL LANDRY

REMARKS: ZERO AT TOP OF CASING

EARTH DATA INCORPORTATED

St. Michaels, Maryland & Exton, Pennsylvania

PHONE NUMBER: 301-745-5046

GEOPHYSICAL WELL LOG:	PERMANENT DATUM: Mean Sea Level	OTHER SERVICES:
CALIPER TEMPERATURE	LOG MEASURED FROM: TOP OF CASING ELEVATION 946.91 Feet above MSL	

EDI JOB NO: 901
WELL: R-1
LOCATION: MASSILLON, OHIO

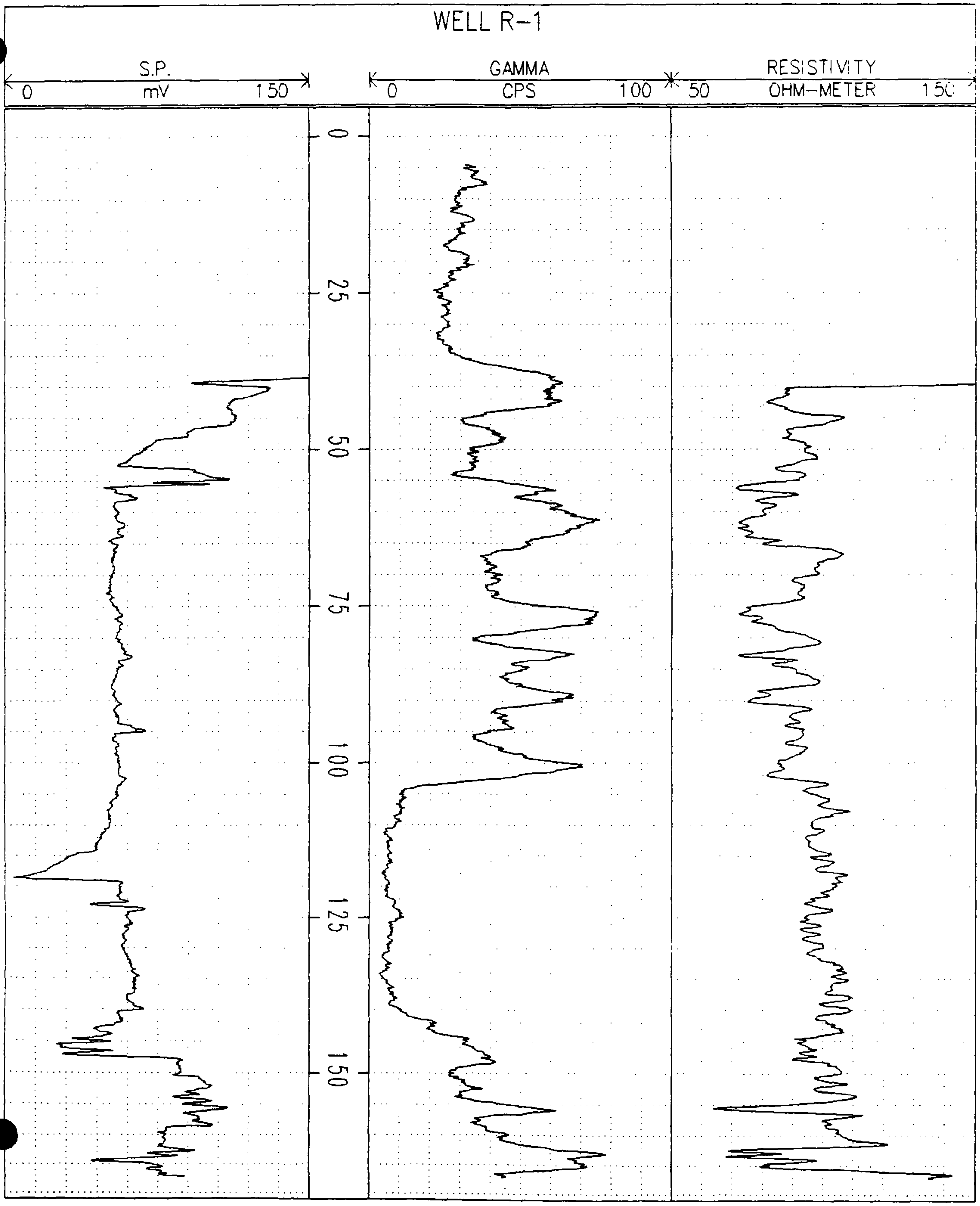
COMPANY: R.F. WESTON
PROJECT: ECKO SITE
WELL IDENTIFICATION: R-1

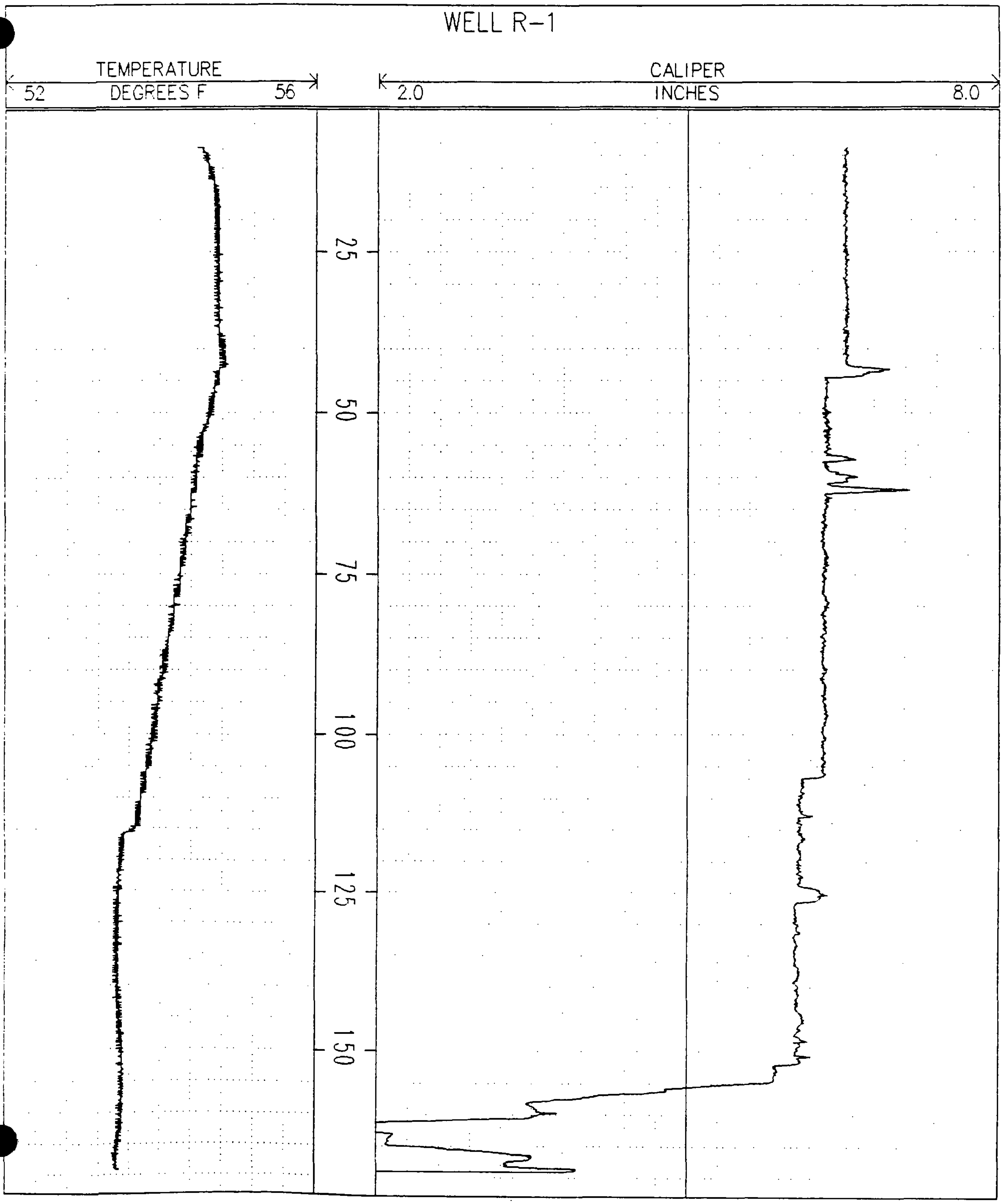
STATE: OHIO
COUNTY: STARK

COORDINATES:
N:
E:
ELEVATION: KB:
DF:
GL:

	Run No. 1		Run No. 1
Date	04/15/91	Fluid Level	
Bottom logged Int.	0'	Fluid Nature	WATER
Top Logged Int.	169'	Fluid Viscosity	
Footage Logged	169'	Fl. Resistivity	
Bottom (Driller)	170'	Fl. Res. at BHT	
Casing (from Log)		Fluid pH	
Casing (Driller)	42'	Circulation Temp	
Casing Size		Bottom Hole Temp	
Bit Size			
		LOGGED BY:	MICHAEL LEDWITH
		WITNESSED BY:	PAUL LANDRY

REMARKS: ZERO AT TOP OF CASING


WELL R-1
S.P.
0
mV
150
GAMMA
0
CPS
100
RESISTIVITY
50
OHM-METER
150
0
25
50
75
100
125
150



WELL R-1
TEMPERATURE
DEGREES F
52
56
CALIPER
INCHES
2.0
8.0
25
50
75
100
125
150

WESTON

EARTH DATA INCORPORTATED

St. Michaels, Maryland & Exton, Pennsylvania

PHONE NUMBER: 301-745-5046

GEOPHYSICAL WELL LOG:	PERMANENT DATUM: Mean Sea Level	OTHER SERVICES:
SELF-POTENTIAL NATURAL GAMMA SINGLE POINT RESISTANCE	LOG MEASURED FROM: TOP OF CASING ELEVATION 946.32 Feet above MSL	

COMPANY: R.F. WESTON PROJECT: ECKO SITE WELL IDENTIFICATION: R-2 STATE: OHIO COUNTY: STARK	COORDINATES: N: E: ELEVATION: KB: DF: GL:

EDI JOB NO: 901
WELL: R-2
LOCATION: MASSILLON, OHIO

	Run No. 1		Run No. 1
Date	04/15/91	Fluid Level	
Bottom logged Int.	0'	Fluid Nature	WATER
Top Logged Int.	153'	Fluid Viscosity	
Footage Logged	153'	Fl. Resistivity	
Bottom (Driller)	155'	Fl. Res. at BHT	
Casing (from Log)		Fluid pH	
Casing (Driller)		Circulation Temp	
Casing Size		Bottom Hole Temp	
Bit Size			
		LOGGED BY:	MICHAEL LEDWITH
		WITNESSED BY:	PAUL LANDRY

REMARKS: ZERO AT TOP OF CASING

EARTH DATA INCORPORTATED

St. Michaels, Maryland & Exton, Pennsylvania

PHONE NUMBER: 301-745-5046

GEOPHYSICAL WELL LOG:	PERMANENT DATUM: Mean Sea Level	OTHER SERVICES:
CALIPER TEMPERATURE	LOG MEASURED FROM: TOP OF CASING ELEVATION 946.32Feet above MSL	

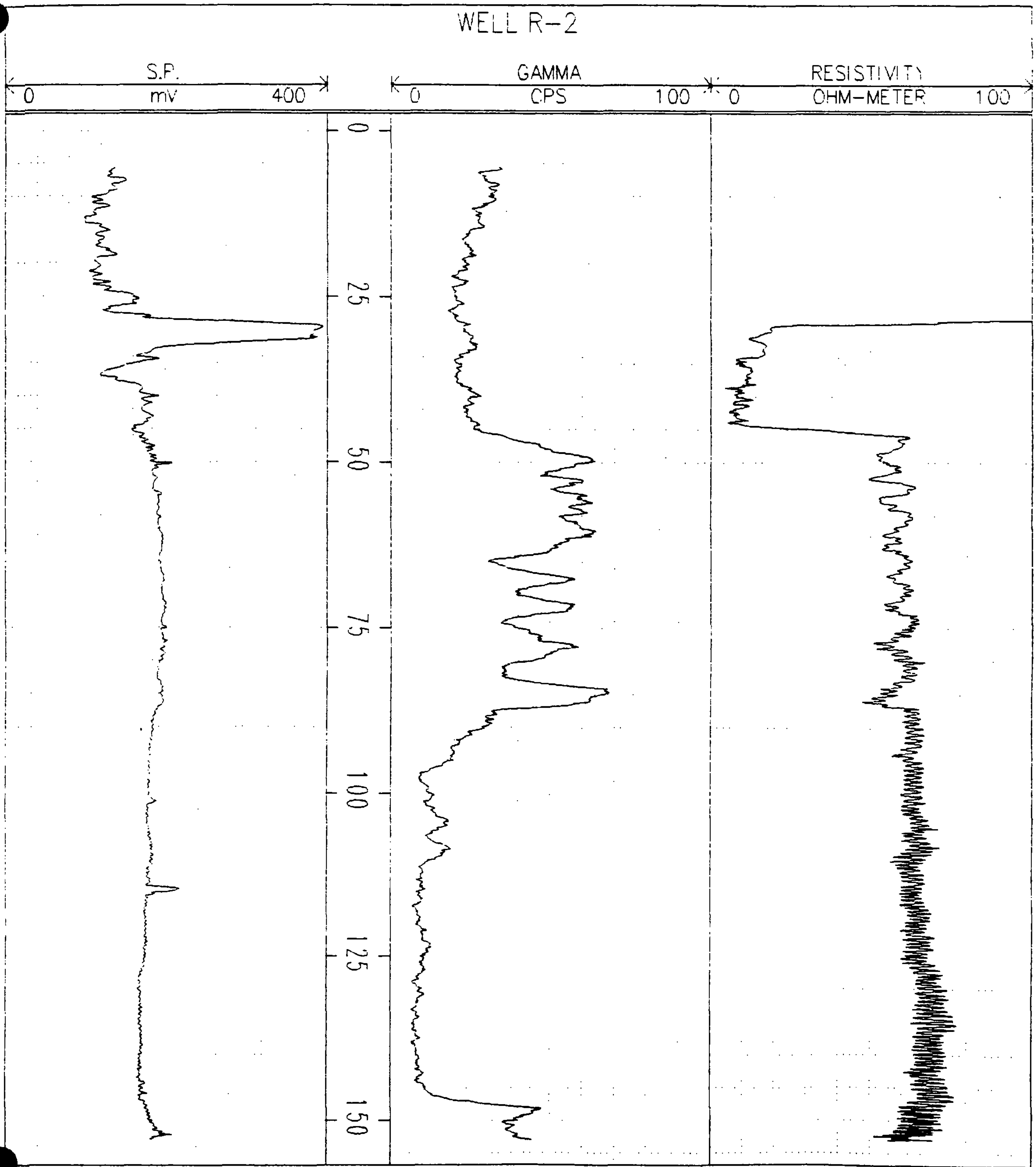
COMPANY: R.F. WESTON PROJECT: ECKO SITE WELL IDENTIFICATION: R-2 STATE: OHIO COUNTY: STARK	COORDINATES: N: E: ELEVATION: KB DF: GL:

EDI JOB NO: 901
WELL: R-2
LOCATION: MASSILLON, OHIO

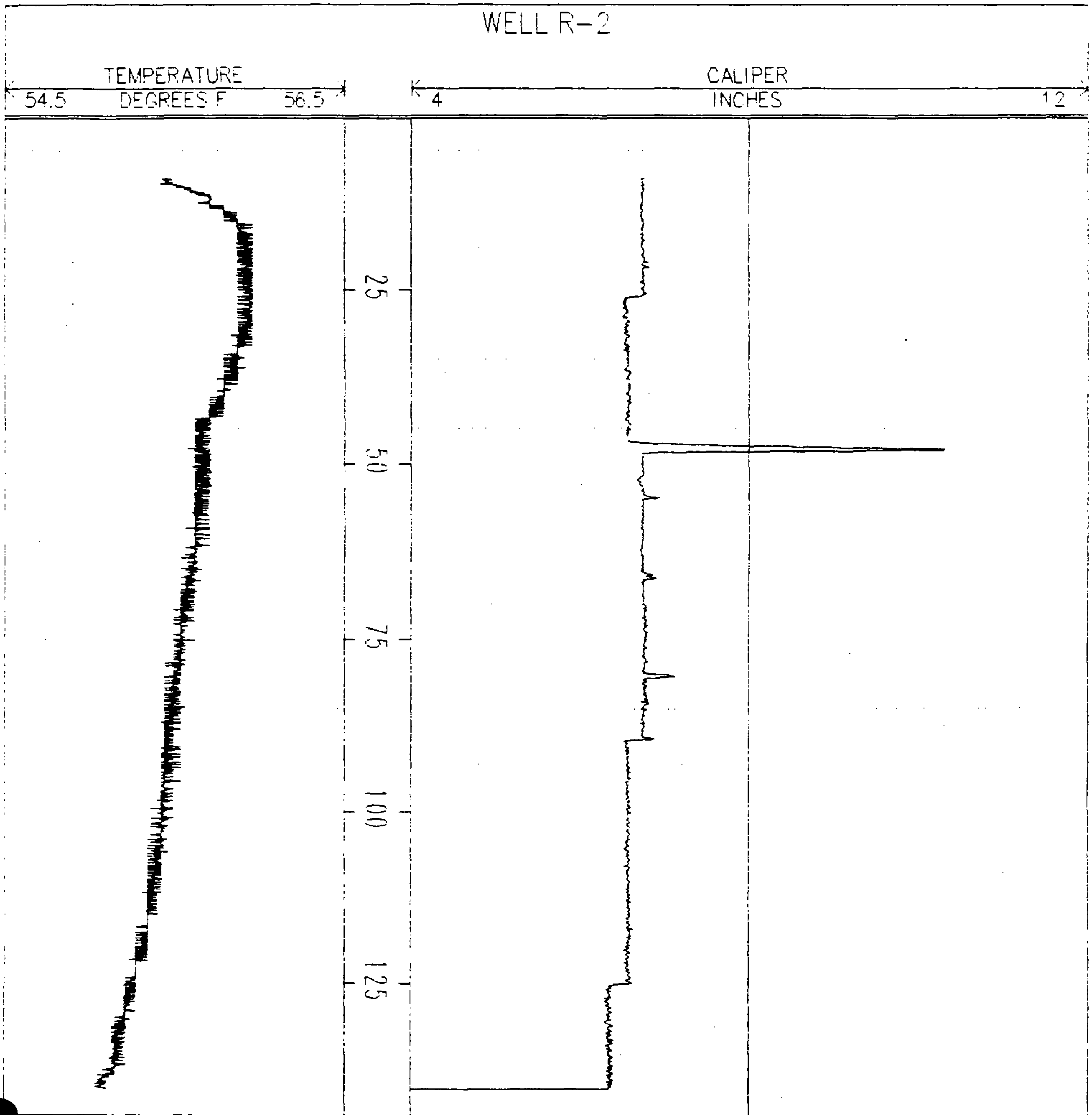
	Run No. 1		Run No. 1
Date	04/15/91	Fluid Level	
Bottom logged Int.	0'	Fluid Nature	WATER
Top Logged Int.	140'	Fluid Viscosity	
Footage Logged	140'	Fl. Resistivity	
Bottom (Driller)	155'	Fl. Res. at BHT	
Casing (from Log)		Fluid pH	
Casing (Driller)		Circulation Temp	
Casing Size		Bottom Hole Temp	
Bit Size			
		LOGGED BY:	MICHAEL LEDWITH
		WITNESSED BY:	PAUL LANDRY

REMARKS: ZERO AT TOP OF CASING

WESTON


WELL R-2
S.P.
0
mV
400
GAMMA
0
CPS
100
RESISTIVITY
0
OHM-METER
100
0
25
50
75
100
125
150

WESTON


WELL R-2
TEMPERATURE
54.5
DEGREES F
56.5
CALIPER
4
INCHES
12
25
50
75
100
125

WESTON

EARTH DATA INCORPORTATED

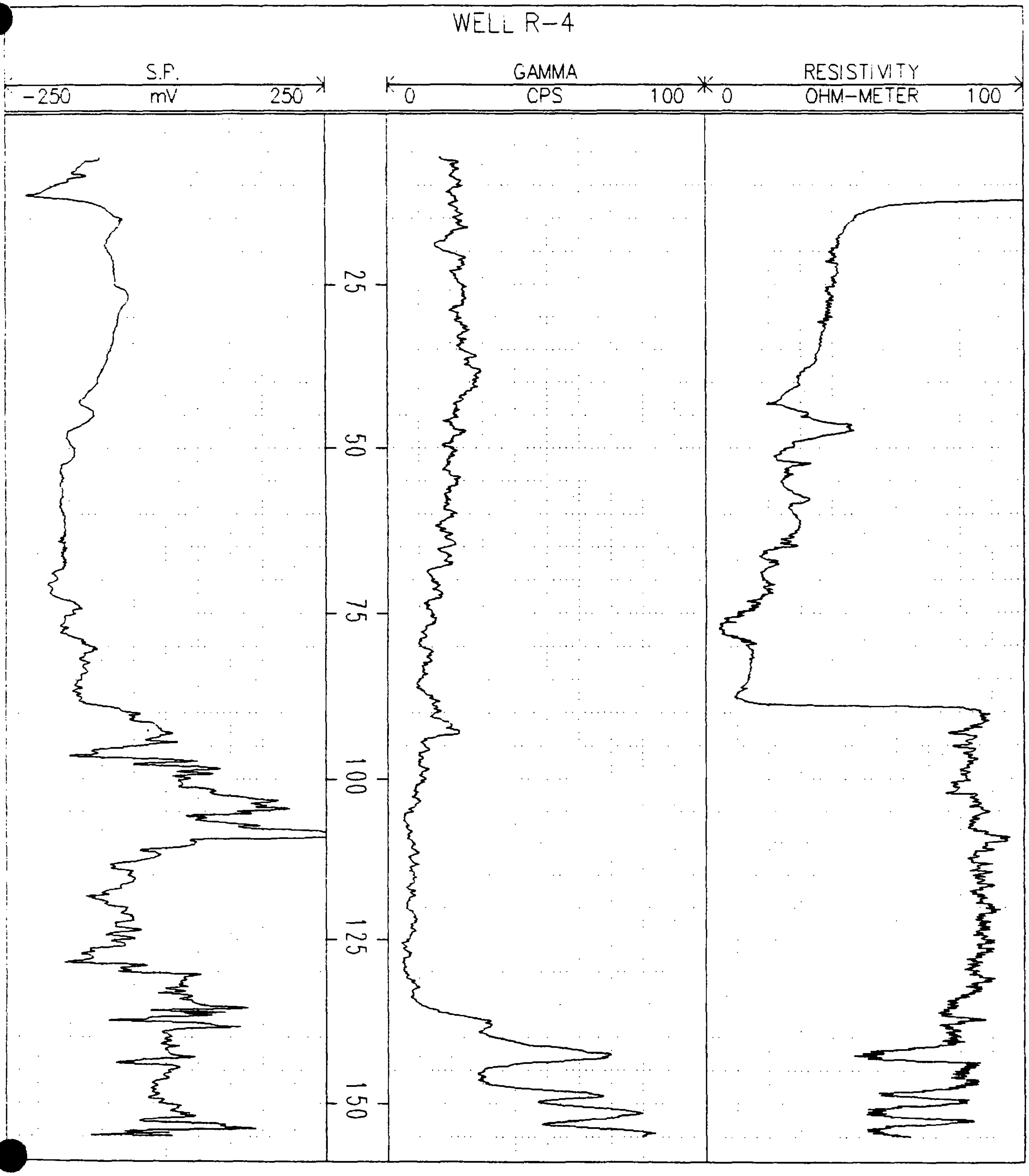
St. Michaels, Maryland & Exton, Pennsylvania

PHONE NUMBER: 301-745-5046

GEOPHYSICAL WELL LOG: SELF-POTENTIAL NATURAL GAMMA SINGLE POINT RESISTANCE	PERMANENT DATUM: Mean Sea Level LOG MEASURED FROM: TOP OF CASING ELEVATION 933.28 Feet above MSL	OTHER SERVICES:
COMPANY: R.F. WESTON PROJECT: ECKO SITE WELL IDENTIFICATION. R-4 STATE: OHIO COUNTY: STARK	COORDINATES: N: E: ELEVATION: KB: DF: GL:	EDI JOB NO: 901 WELL: R-4 LOCATION: MASSILLON, OHIO

	Run No. 1		Run No. 1
Date	04/15/91	Fluid Level	
Bottom logged Int.	0'	Fluid Nature	WATER
Top Logged Int.	155'	Fluid Viscosity	
Footage Logged	155'	Fl. Resistivity	
Bottom (Driller)	155'	Fl. Res. at BHT	
Casing (from Log)		Fluid pH	
Casing (Driller)		Circulation Temp	
Casing Size		Bottom Hole Temp	
Bit Size			
		LOGGED BY:	MICHAEL LEDWITH
		WITNESSED BY:	PAUL LANDRY

REMARKS: ZERO AT TOP OF CASING


WELL R-4
S.P.
-250
mV
250
GAMMA
0
CPS
100
RESISTIVITY
0
OHM-METER
100
25
50
75
100
125
150

APPENDIX B

FALLING HEAD TEST DATA AND CALCULATIONS

EKCO PACKER TEST APRIL, 1991
R-2 GROUT SEAL FALLING HEAD TEST

TIME(min)	DTW(ft)
0.00	30.06
1.00	4.28
1.76	6.68
2.58	9.35
3.15	10.97
3.49	11.87
3.88	12.85
4.44	14.21
4.81	15.02
5.06	15.52
5.46	16.28
5.87	17.08
6.45	17.83
6.80	18.58
7.48	19.40
7.91	20.16
8.30	20.49
8.75	20.97
8.95	21.20
9.62	22.04
10.05	22.39
10.36	22.69
11.00	23.19
11.37	23.43
12.35	24.98
13.85	24.63
14.25	25.00
14.50	25.05
15.00	25.26
15.55	25.50
15.90	25.57
16.13	25.62
16.37	25.67
16.75	25.75
17.19	25.89
17.40	25.91

TIME(min)	DTW(ft)
17.61	25.98
17.86	26.02
18.13	26.07
19.03	26.24
19.67	26.34
20.28	26.38
20.57	26.50
21.29	26.53
21.73	26.58
23.17	26.74
23.90	26.78
23.90	26.78
24.35	26.78
25.70	26.88
26.40	26.92
27.33	26.96
27.86	26.99
28.11	27.01

** 30-Apr-91**

SLUG TEST ANALYSIS

Site location: EKCO
Well ID: R-2

Test No.:ZONE 3 Step No.:FALLING HEAD

Total well depth:	49	feet		
Depth to water:	30.06	feet		
Screen length (Le):	2	feet		
Well diameter:	6	inches		
Borehole diameter:	6.5	inches	Rc= 0.25	feet
Sat. thickness (Lw):	18.94	feet	rw= 0.2708	feet

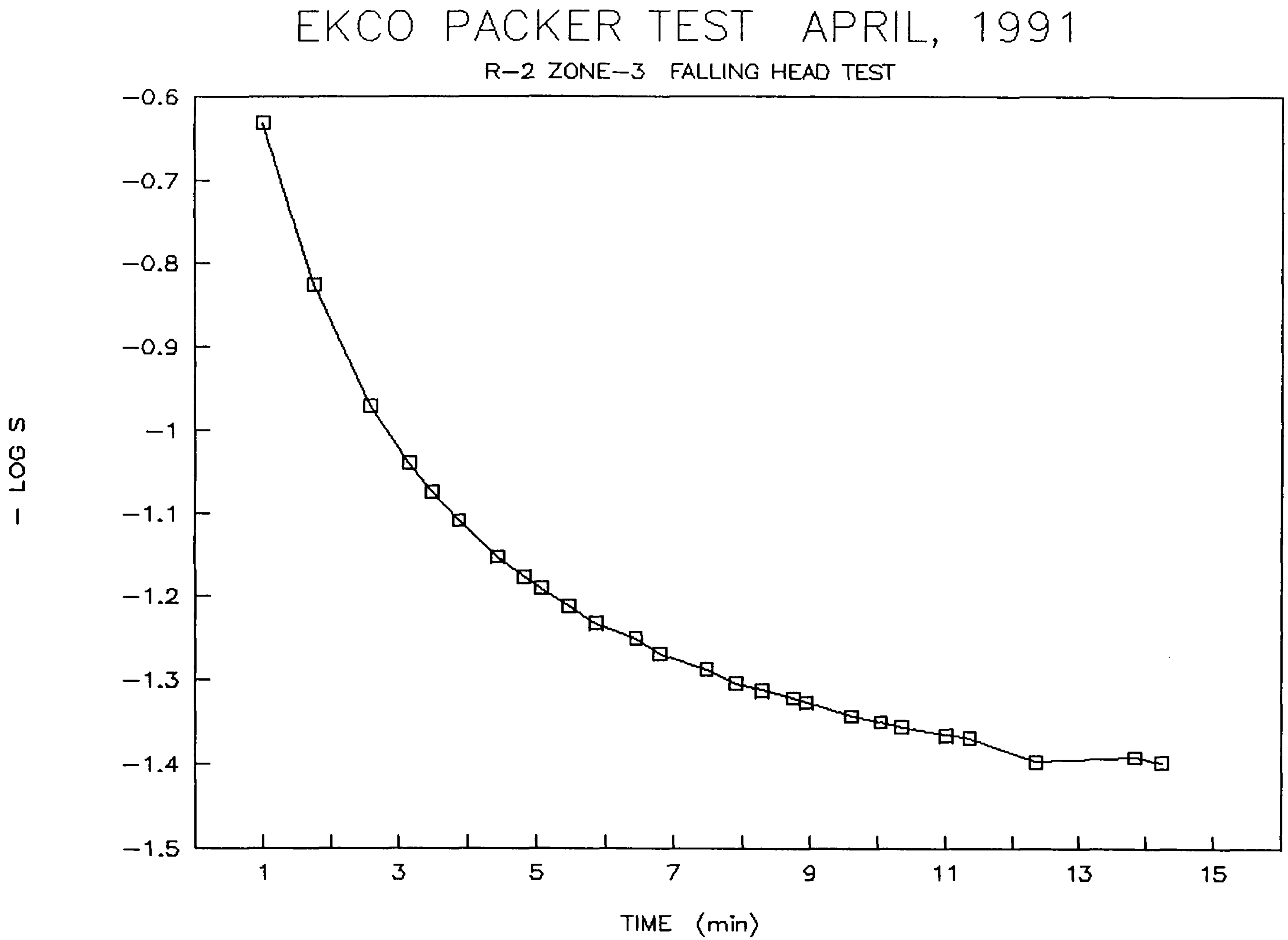
From type curve:
Where Le/rw=7.3846
C= 1

ln(Re/rw)= 2.5356

Bouwer and Rice Results:
==========================
r squared = 0.9894

Hydraulic conductivity = 6.29 ft/day

Effective radial distance
of slug test = 3.4 feet



EKCO PACKER TEST APRIL, 1991
R–2 ZONE–3 FALLING HEAD TEST
– LOG S
–0.6
–0.7
–0.8
–0.9
–1
–1.1
–1.2
–1.3
–1.4
–1.5
1
3
5
7
9
11
13
15
TIME (min)

APPENDIX C

GEOLOGIC LOGS FOR WELLS R-1, R-2, R-3 and R-4

THE OHIO DRILLING CO.

INCORPORATED

MASSILLON, OHIO

Q-1

DRILLED FOR Ekco Housewares - Massillon, Ohio HOLE NO. 1 - 6"
Rotary Hole

DRILLED BY Paul Ortz (McKay & Gould) DRILLER COMPLETED Oct. 25, 19 84

LOCATION See location plat

THICKNESS OF STRATA	STRATA	TOTAL DEPTH	HEAVED	WATER FROM SURFACE
41 ft.	Wash	41 ft.		
3 ft.	Sandy Shale	44 ft.		
22 ft.	Sandstone (white, hard & dry)	66 ft.		
2 ft.	Shale	68 ft.		
11 ft.	Sandstone	79 ft.		
4 ft.	Shale	83 ft.		
8 ft.	White Sandstone	91 ft.		
12 ft.	White Sandstone with Black Streaks	103 ft.		
4 ft.	Shale	107 ft.		
15 ft.	Yellow Sandstone	122 ft.		
17 ft.	Yellow & Brown Sandstone	139 ft.		
8 ft.	White Sandstone	147 ft.		
2 ft.	Shale	149 ft.		
16 ft.	White Sandstone	165 ft.		
10 ft.	Shale - Sandy Streaks	175 ft.		

Cased to 42 ft. with 6" pipe.

Test hole pumped at the following depths.

Depth	Static Water Level	Specific Capacity
60 - 80 ft.	38.0 ft.	0.34 gpm per foot of drawdown
80 - 100 ft.	38.0 ft.	0.38 gpm per foot of drawdown
100 - 120 ft.	42.0 ft.	0.65 gpm per foot of drawdown
120 - 140 ft.	39.7 ft.	5.0 gpm per foot of drawdown
140 - 160 ft.	32.5 ft.	less than 0.04 gpm per foot of drawdown
160 - 170 ft.	37.5 ft.	less than 0.04 gpm per foot of drawdown

THE OHIO DRILLING CO.

INCORPORATED

MASSILLON, OHIO

R-2

DRILLED FOR Ekco Housewares - Massillon, Ohio HOLE NO. 2 - 6" Rotary Hole

DRILLED BY Paul Ortz (McKay & Gould) DRILLER COMPLETED Oct. 29, 19 84

LOCATION See location plat

THICKNESS OF STRATA	STRATA	TOTAL DEPTH	HEAVED	WATER FROM SURFACE
44 ft.	Top	44 ft.		
40 ft.	Sandstone	84 ft.		
3 ft.	Shale	87 ft.		
22 ft.	Sandstone (brown)	109 ft.		
2 ft.	Shale	111 ft.		
6 ft.	Sandstone (brown)	117 ft.		
3 ft.	Sandstone (reddish)	120 ft.		
23 ft.	Sandstone (brown with black streaks)	143 ft.		
26 ft.	Sandstone (white)	169 ft.		
10 ft.	Shale	179 ft.		

Cased to 46 ft. with 6" pipe.

Test hole pumped at the following depths.

Depth	Static Water Level	Specific Capacity
46.5 - 179 ft.	43.0 ft.	0.91 gpm per foot of drawdown
60 - 80 ft.	34.8 ft.	0.91 gpm per foot of drawdown
80 - 100 ft.	36.5 ft.	0.22 gpm per foot of drawdown
100 - 120 ft.	39.5 ft.	0.17 gpm per foot of drawdown
120 - 140 ft.	34.8 ft.	0.11 gpm per foot of drawdown
140 - 150 ft.	39.1 ft.	0.10 gpm per foot of drawdown

Test hole filled to 150 feet during pumping.

THE OHIO DRILLING CO.
INCORPORATED
MASSILLON, OHIO

R-3

DRILLED FOR Ekco Housewares - Massillon, Ohio HOLE NO. 3 - 6"
Rotary Hole

DRILLED BY Paul Ortz (McKay & Gould) DRILLER COMPLETED Oct. 30, 19 84

LOCATION See location plat

THICKNESS OF STRATA	STRATA	TOTAL DEPTH	HEAVED	WATER FROM SURFACE
32 ft.	Top	32 ft.		
16 ft.	White Sandstone	48 ft.		
8 ft.	Shale	56 ft.		
13 ft.	Sandstone (damp - brown)	69 ft.		
12 ft.	Sandy Shale	81 ft.		
36 ft.	Sandstone (brown)	117 ft.		
11 ft.	Sandstone (reddish)	128 ft.		
2 ft.	Shale	130 ft.		
13 ft.	Sandstone (brown)	143 ft.		
3 ft.	Shale	146 ft.		
24 ft.	Sandstone (white)	170 ft.		
5 ft.	Shale with Sandy Streaks	175 ft.		

Cased to 37 ft. with 6" pipe.

Test hole pumped at the following depths.

Depth	Static Water Level	Specific Capacity
37.5 - 160 ft.	41.2 ft.	0.63 gpm per foot of drawdown
60 - 80 ft.	44.5 ft.	0.32 gpm per foot of drawdown
80 - 100 ft.	44.6 ft.	0.47 gpm per foot of drawdown
100 - 120 ft.	39.5 ft.	0.10 gpm per foot of drawdown
120 - 140 ft.	42.0 ft.	0.15 gpm per foot of drawdown
140 - 160 ft.	35.6 ft.	0.01 gpm per foot of drawdown

Test hole filled to 160 feet during pumping.

THE OHIO DRILLING CO.

INCORPORATED

MASSILLON, OHIO

DRILLED FOR Ekco Housewares - Massillon, Ohio HOLE NO. R-4

6" Rotary Hole

DRILLED BY John King and McKay & Gould DRILLER COMPLETED July 19, 19 85

LOCATION Northeastern corner of property, approximately 250 ft. east of R-2

THICKNESS OF STRATA	STRATA	TOTAL DEPTH	HEAVED	WATER FROM SURFACE
21 ft.	Clay & Shale	21 ft.		
10 ft.	Clay, Sand & Stones	31 ft.		
19 ft.	Clay, Gravel & Sand	50 ft.		
32 ft.	Sand, Gravel & Clay	82 ft.		13' 0"
10 ft.	Clay, Sand & Gravel	92 ft.		
37 ft.	Sandstone	129 ft.		13' 8"
1 ft.	Shale	130 ft.		
17 ft.	Sandstone	147 ft.		13' 8"
2 ft.	Shale	149 ft.		[illegible]
11 ft.	Sandstone	160 ft.		13' 8"
5 ft.	Shale	165 ft.		

Cased to 92 feet with 6" pipe.

Test hole pumped at the following depths.

Depth	Static Water Level	Specific Capacity
50'	13' 0"	- -
60'	13' 0"	- -
90' - 100'	13' 8"	1.5 gpm per ft. of drawdown
100' - 120'	13' 8"	0.8 gpm per ft. of drawdown
120' - 140'	13' 8"	0.6 gpm per ft. of drawdown
140' - 160'	13' 8"	2.1 gpm per ft. of drawdown

No [illegible]

3.3.2 Reporting

Following completion of the IRM activities, an IRM report will be submitted to EPA Region V and will include the results of abandonment of well D-4-30, the geophysical logging, liner installations in the W-wells, rehabilitation of the R-wells, and postrehabilitation groundwater monitoring in the monitoring wells. Included in the reports will be geophysical logs, well construction diagrams, groundwater contour maps of the postrehabilitation monitoring, and text describing the procedures, results, and recommendations for any further corrective actions, if needed.

SECTION 4
SCHEDULE

The schedule for implementation of the IRM activities is contingent on approval from EPA Region V. From the date of Agency approval, mobilization to the site would be affected within 2 weeks. This time would be required for obtaining the appropriate well materials and for notifying the subcontractors who will be providing the geophysical logging services and pump hoist rig. The estimated duration of the actual IRM activities (well rehabilitations only) is 11 days. Assuming 1 month of postrehabilitation monitoring, the IRM report would be submitted 2½ months after receiving EPA approval.

SECTION 5

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WESTON. May 1989. *Groundwater Quality Assessment Report for EKCO Housewares, Inc., Massillon, Ohio.* Prepared for EPA, Region V and OEPA.

WESTON. May 1990. *RFI/CMS Work Plan for EKCO Housewares, Inc., Massillon, Ohio.* Prepared for EPA, Region V.

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Leak Computer - Quick Look Report
(PAGE 1)

Test Number: 91032097.A38

FOR: 2000 gallon SOLV.BLD. Tank
LOCATION: EKCO HOUSEWARES MASSILION, OH.
DATE OF TEST: 03/20/91
LEAK COMPUTER S/N: 89071705

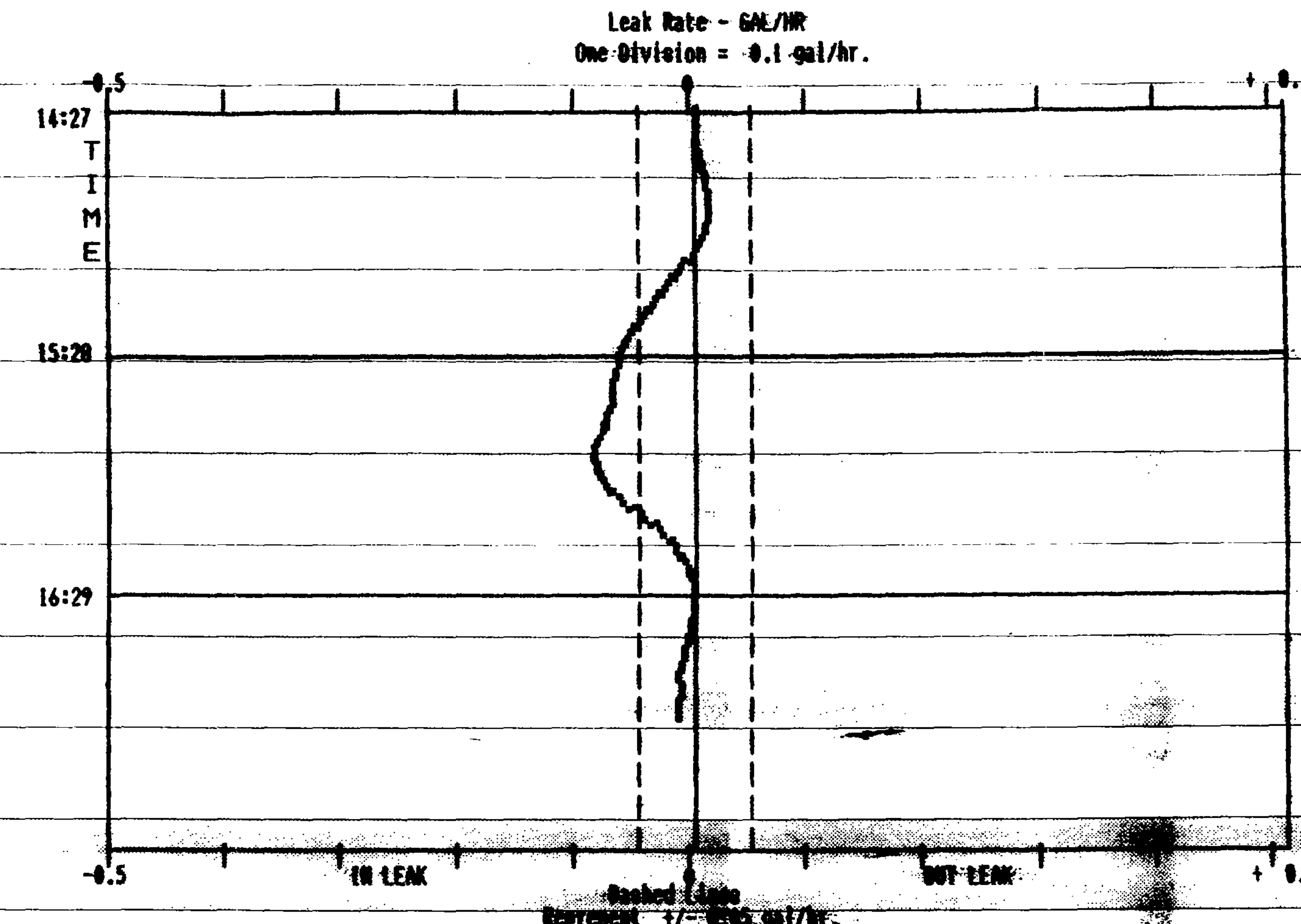
Test Level 38 Inches ABOVE Tank Top
Data from Channel A
Manifolding: None
COE: 0.000625 Spec. Gr.: 0.83 Tank Temp: 45.7
Leak Rate Average of 20 Cycles
Total Test Time: 2:18 hours

TEST RESULTS ®
Final Average Leak Rate: less than 0.05 gal/hr.
Rate of Temperature change: -0.0415 deg F/hr.
Rate of Volume change: -0.0092 gal/hr.
0.99 Error Band: +/- 0.01 gal/hr.
Tank and System: TIGHT @ 38 inches ABOVE Tank Top.

Test Technician: [signature]
STEVE MILLS

Leak Computer® - Quick Look Report
(PAGE 2)

Test Number: 91032097.A38

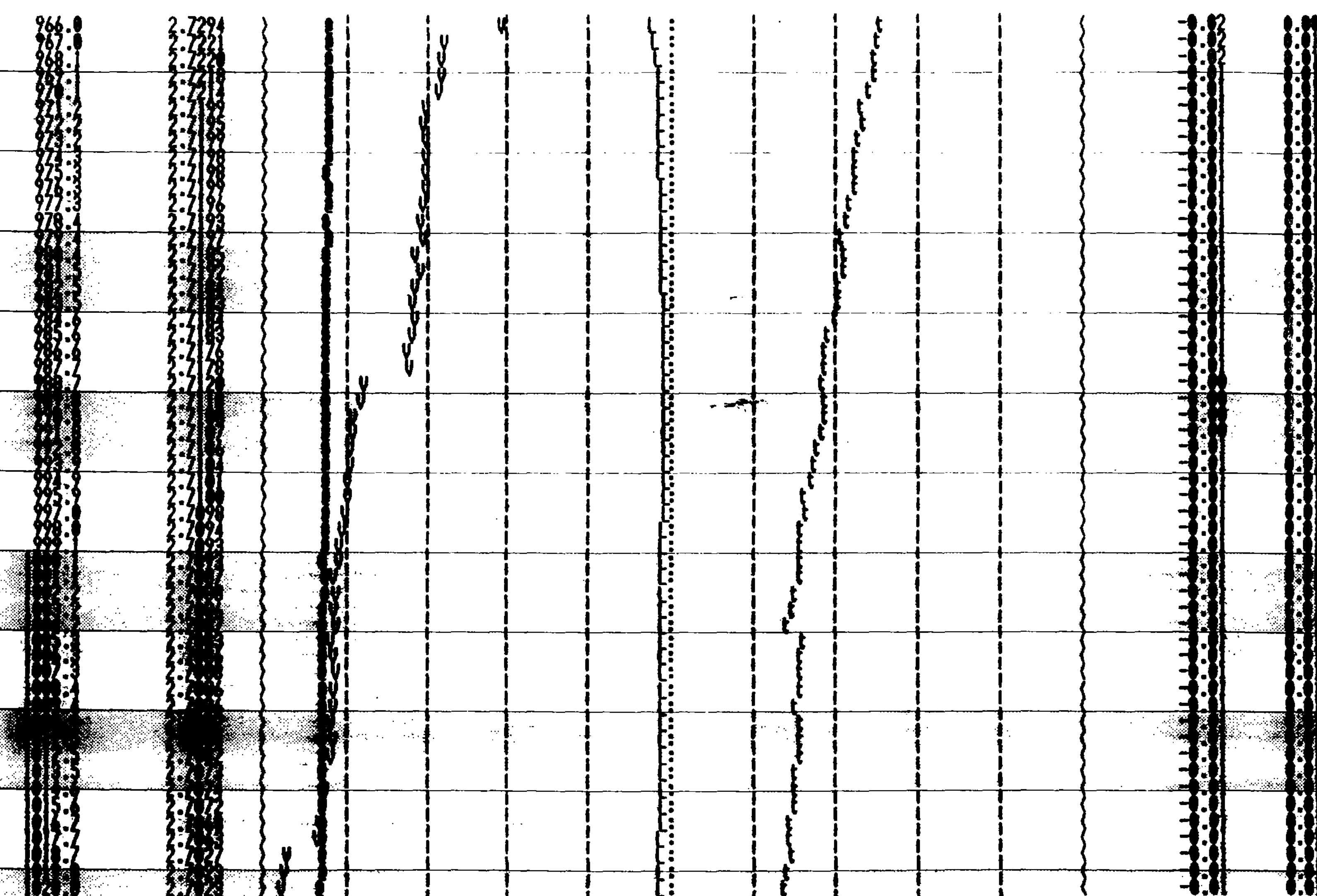


STRIP CHART FOR DATA RECORD: 91032097.A38 OF 2000 GALLON SOLV.BLD. TANK

Test Address: EKCO HOUSEWARES MASSILION, OH.
Test Operator: STEVE MILLS

LEAK RATE AVG OF 60 CYCLES TANK TEMP @ START: 45.8 F
COE: 0.000625 DEN: 0.828 LFD: 6.0 Manifolding: None

		<------------ @ = 10.0F ------------>	AVG	THREE
		<------------ t = 0.5 F ------------>	LEAK	STD
TIME	GAL	<------------ V = 0.1 gal ------------>	RATE	DEV



END OF STRIP CHART
DATA COLLECTED ON LEAK COMPUTER SN 89071705

Leak Computer – Quick Look Report
(PAGE 1)

Test Number: 91032094.B40

FOR: 4000 gallon WATER Tank
LOCATION: EKCO HOUSEWARES MASSILION, OH.
DATE OF TEST: 03/20/91
LEAK COMPUTER S/N: 89071705

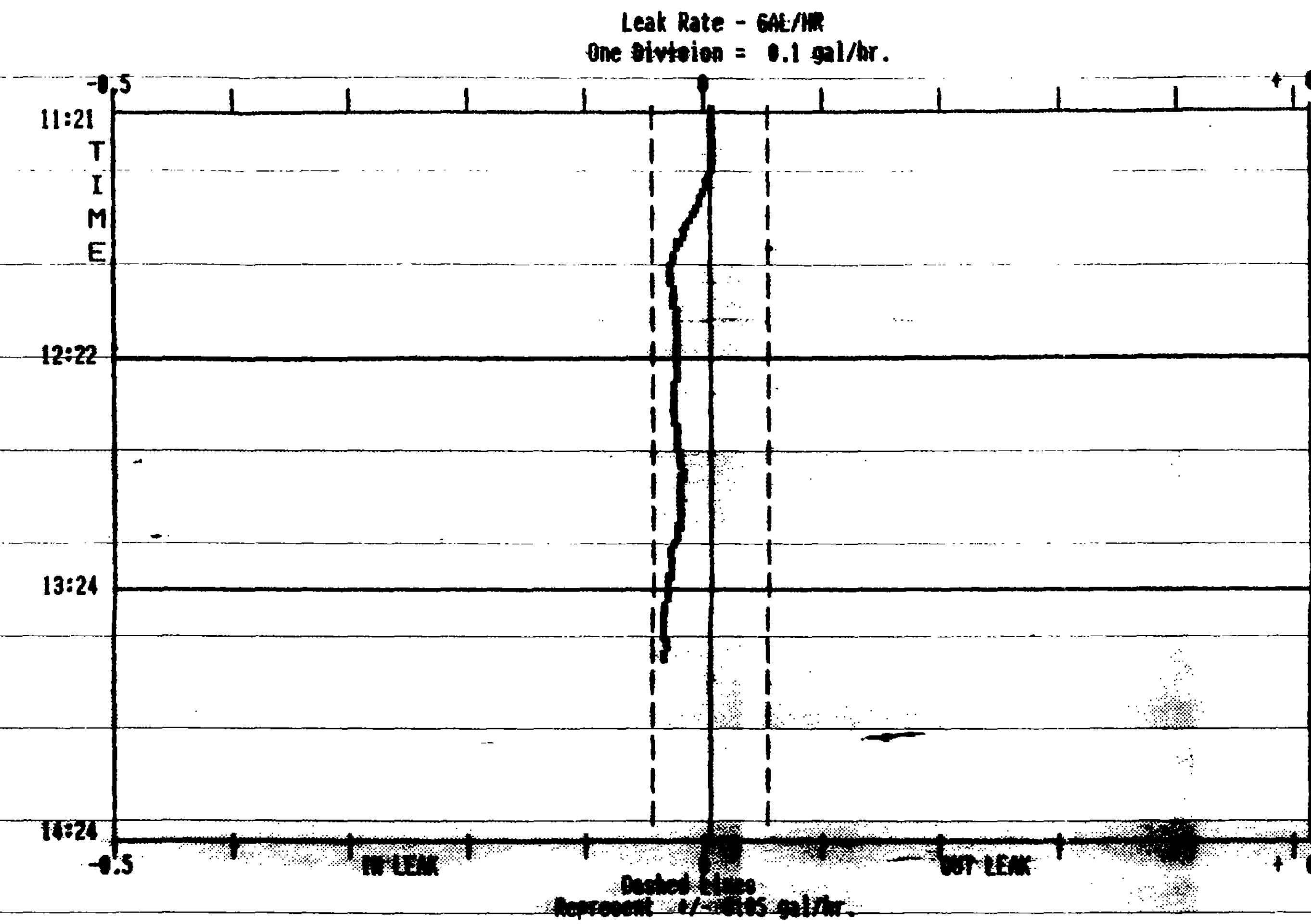
Test Level 40 Inches ABOVE Tank Top
Data from Channel B
Manifolding: None
COE: 0.000115 Spec. Gr.: 0.99 Tank Temp: 50.6
Leak Rate Average of 20 Cycles
Total Test Time: 2:02 hours

TEST RESULTS (B)
Final Average Leak Rate: less than 0.05 gal/hr.
Rate of Temperature change: -0.0429 deg F/hr.
Rate of Volume change: -0.0042 gal/hr.
0.99 Error Band: +/- 0.01 gal/hr.
Tank and System: TIGHT @ 40 inches ABOVE Tank Top.

Test Technician: [signature]
STEVE MILLS

Leak Computer(B) – Quick Look Report
(PAGE 2)

Test Number: 91032094.B40

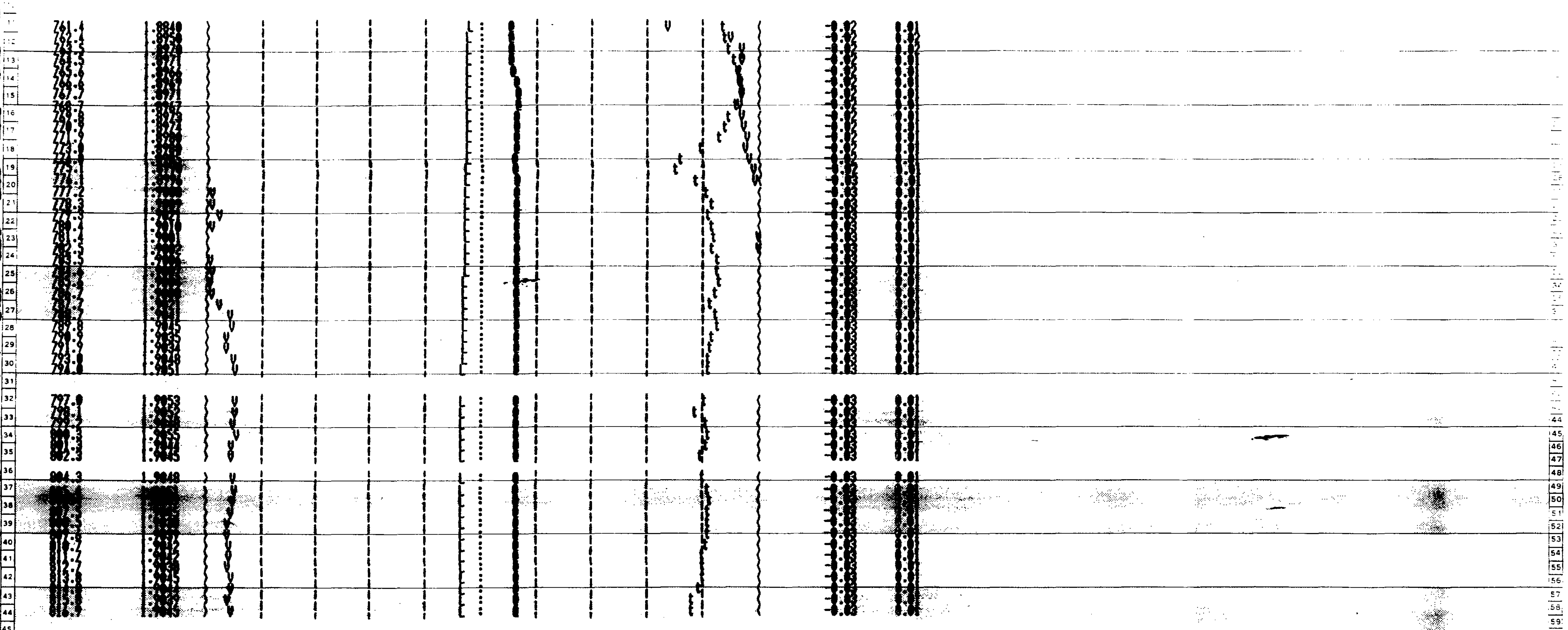


STRIP CHART FOR DATA RECORD: 91032094.B40 OF 4000 GALLON WATER TANK

~~Test Address: EKCO HOUSEWARES MASSILION, OH.~~
Test Operator: STEVE MILLS

~~LEAK RATE AVG OF 60 CYCLES TANK TEMP @ START: 50.5 F~~
COE: 0.000115 DEN: 0.989 LFD: 6.0 Manifolding: None

TIME	GAL	<------ @ = 10.0F ------> <------ t = 0.5 F ------> <------ V = 0.1 gal ------>	AVG LEAK RATE	THREE STD DEV



END OF STRIP CHART
DATA COLLECTED ON LEAK COMPUTER SN 89071705

PRINTED IN U.S.A. 3

Leak Computer® – Quick Look Report (PAGE 1)

Test Number: 91032087.B38

FOR: 4000 gallon WATER Tank
LOCATION: EKCO HOUSEWARE MASSILLON OH
DATE OF TEST: 03/20/91
LEAK COMPUTER S/N: 87091108

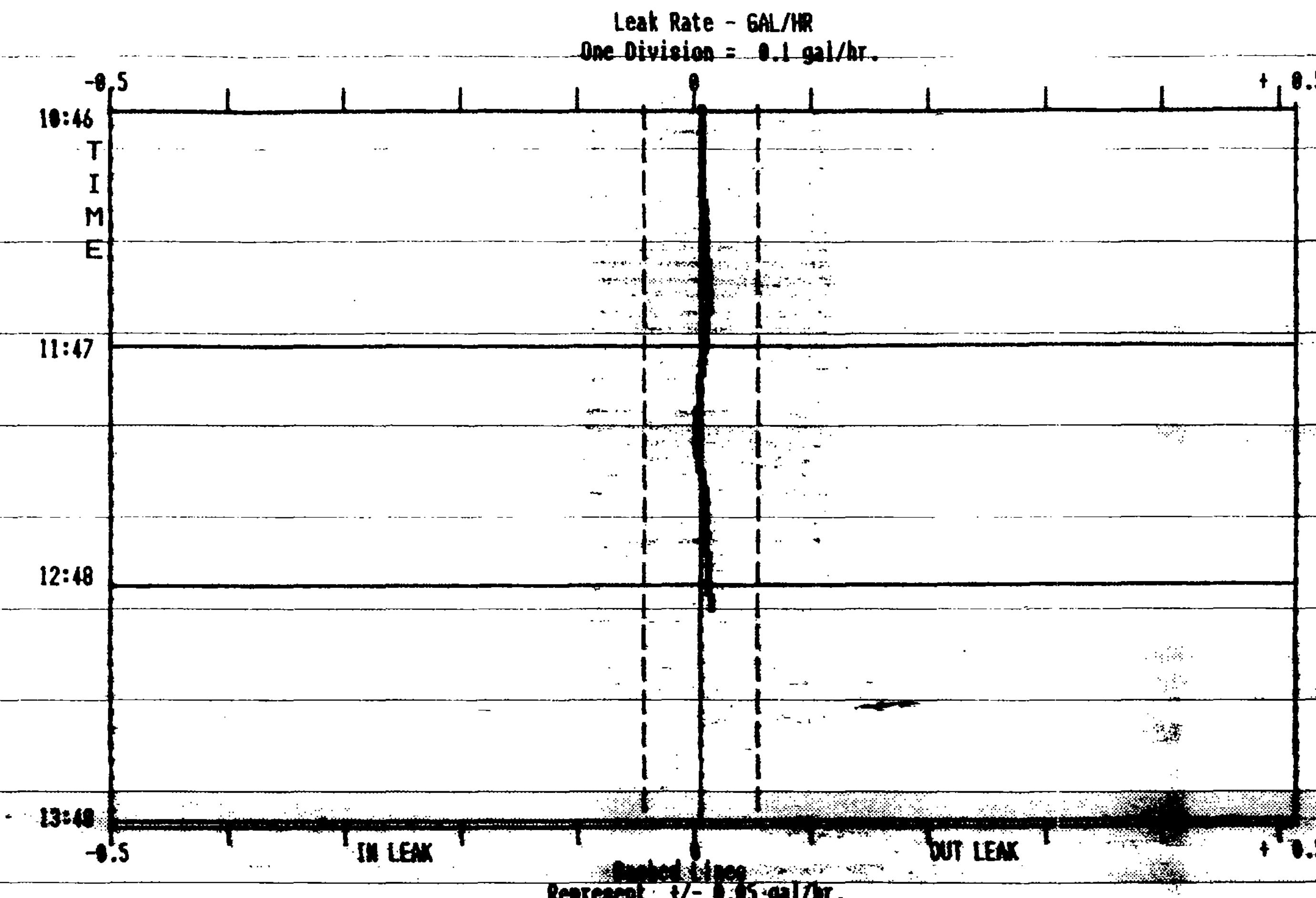
Test Level 38 Inches ABOVE Tank Top
Data from Channel B
Manifolding: None
COE: 0.000115 Spec. Gr.: 1.00 Tank Temp: 53.5
Leak Rate Average of 20 Cycles
Total Test Time: 1:53 hours

TEST RESULTS
Final Average Leak Rate: less than 0.05 gal/hr.
Rate of Temperature change: -0.0102 deg F/hr.
Rate of Volume change: 0.0060 gal/hr.
0.99 Error Band: +/- 0.00 gal/hr.
Tank and System: TIGHT @ 38 inches ABOVE Tank Top.

Test Technician:
JOHN DOUGLAS/ DAVE BISKNER

Leak Computer® – Quick Look Report (PAGE 2)

Test Number: 91032087.B38

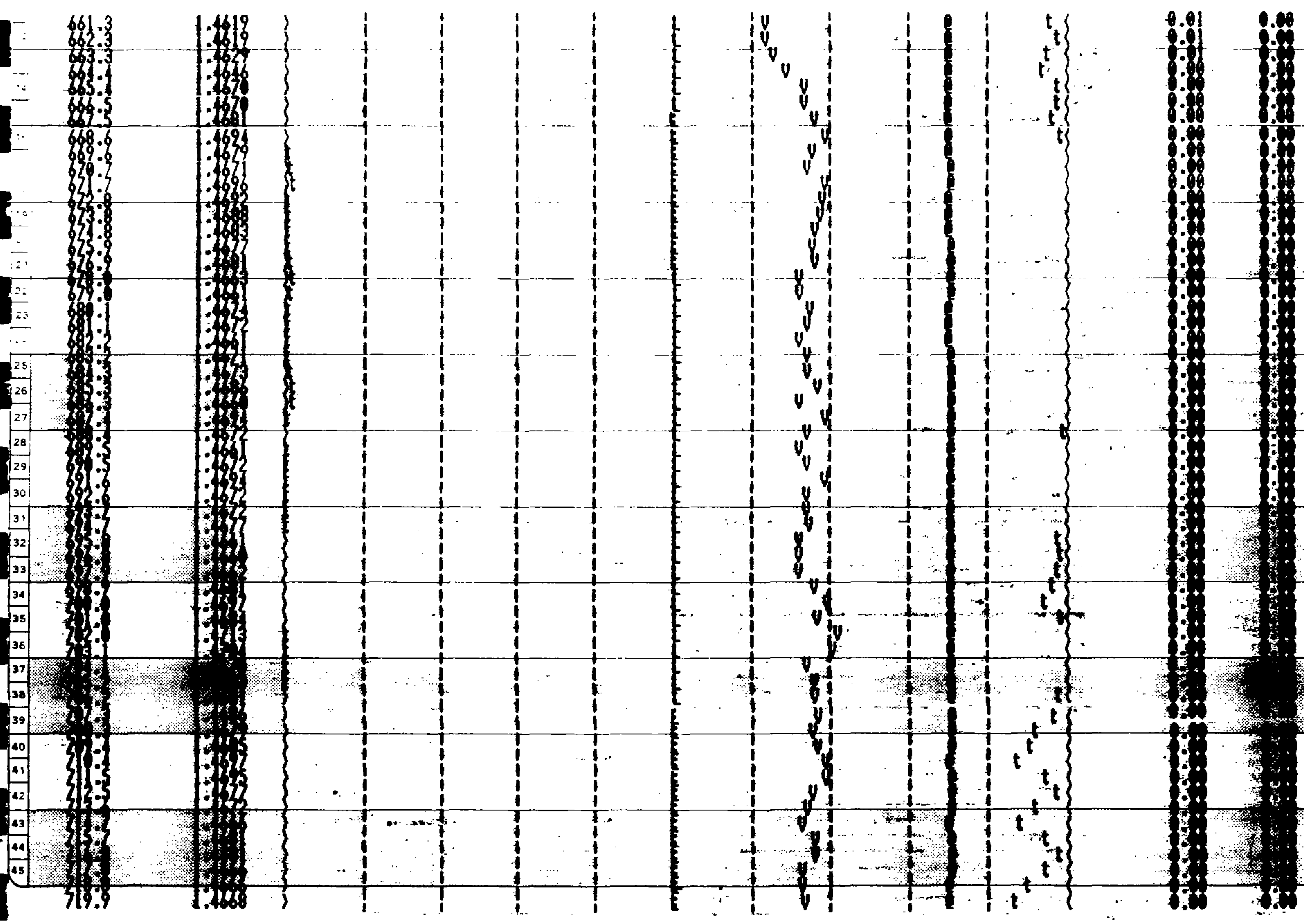


STRIP CHART FOR DATA RECORD: 91032087.B38 OF 4000 GALLON WATER TANK

Test Address: EKCO HOUSEWARE MASSILLON OH
Test Operator: JOHN DOUGLAS/ DAVE BISKNER

LEAK RATE AVG OF 60 CYCLES TANK TEMP @ START: 53.5 F
COE: 0.000115 DEN: 1.004 LFD: 6.0 Manifolding: None

TIME	GAL		AVG LEAK RATE	THREE STD DEV
		<------------ @ = 10.0F ------------>		
		<------------ t = 0.5 F ------------>		
		<------------ V = 0.1 gal ------------>		



END OF STRIP CHART

DATA COLLECTED ON LEAK COMPUTER SN 87091108

PRINTED IN U.S.A. 3

Leak Computer® - Quick Look Report
(PAGE 1)

Test Number: 91032086.A36

FOR: 3000 gallon SOLVENT BL Tank
LOCATION: EKCO HOUSEWARE MASSILLON OH
DATE OF TEST: 03/20/91
LEAK COMPUTER S/N: 87091108

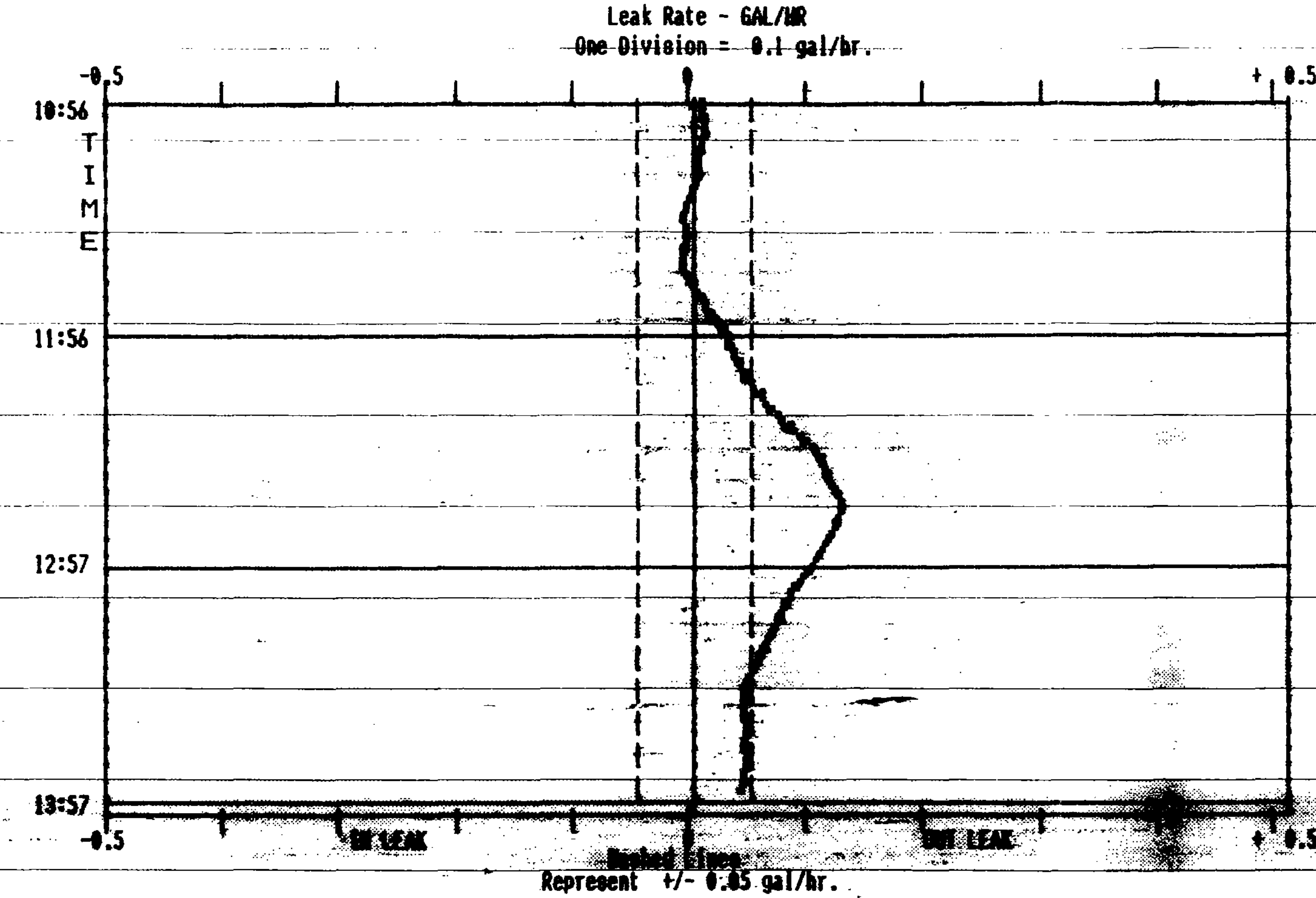
Test Level 36 Inches ABOVE Tank Top
Data from Channel A
Manifolding: None
COE: 0.000625 Spec. Gr.: 0.79 Tank Temp: 54.1
Leak Rate Average of 20 Cycles
Total Test Time: 2:57 hours

TEST RESULTS
Final Average Leak Rate: less than 0.05 gal/hr.
Rate of Temperature change: 0.0181 deg F/hr.
Rate of Volume change: 0.0012 gal/hr.
0.99 Error Band: +/- 0.00 gal/hr.
Tank and System: TIGHT @ 36 inches ABOVE Tank Top.

Test Technician:
JOHN DOUGLAS/ DAVE BISKNER

Leak Computer® - Quick Look Report
(PAGE 2)

Test Number: 91032086.A36



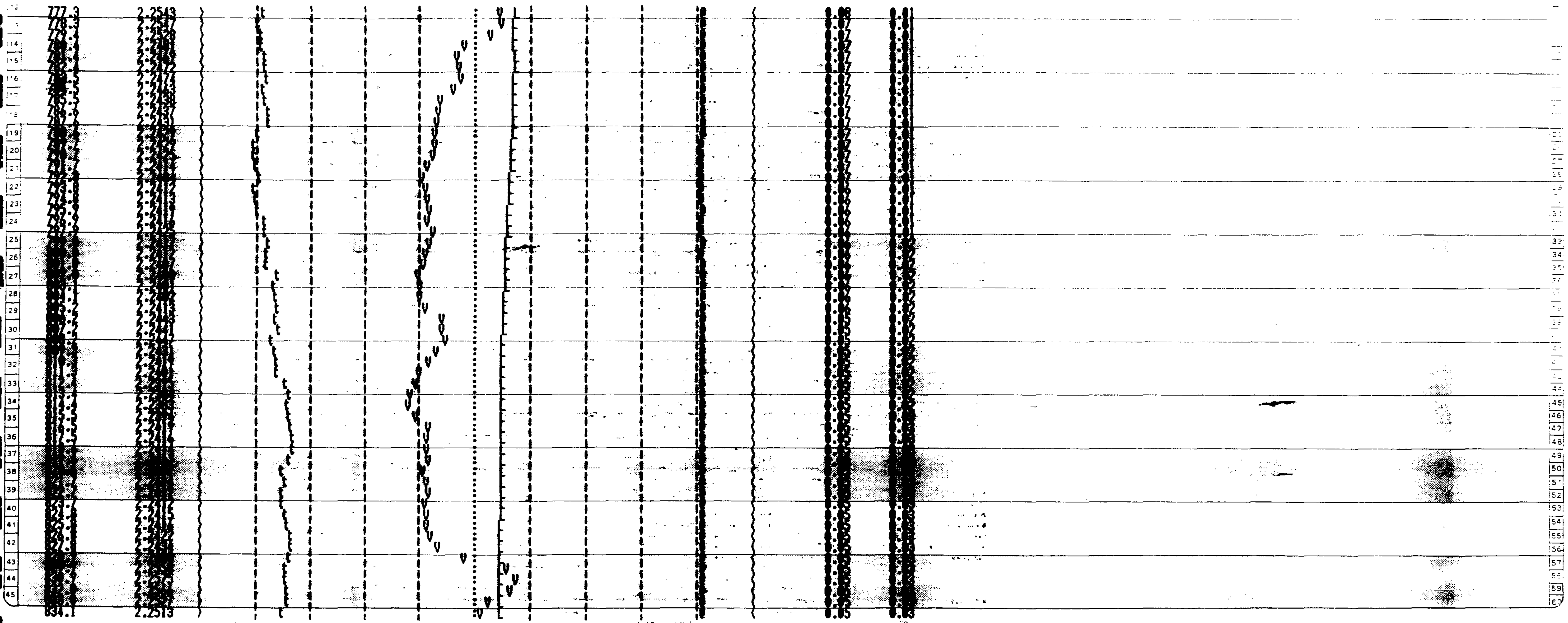
PRINTED IN USA 3

STRIP CHART FOR DATA RECORD: 91032086.A36 OF 3000 GALLON SOLVENT BL TANK

Test Address: EKCO HOUSEWARE MASSILLON OH
Test Operator: JOHN DOUGLAS/ DAVE BISKNER

LEAK RATE AVG OF 60 CYCLES TANK TEMP @ START: 54.1 F
COE: 0.000625 DEN: 0.787 LFD: 6.0 Manifolding: None

		<------------------ @ = 10.0F ------------------>	AVG	THREE
		<------------------ t = 0.3 F ------------------>	LEAK	STD
TIME	GAL	<------------------ V = 0.1 gal ------------------>	RATE	DEV



END OF STRIP CHART

DATA COLLECTED ON LEAK COMPUTER SN 87091108

DRAFT INTERIM REMEDIAL MEASURES REPORT
FOR UNDERGROUND STORAGE TANKS AT
EKCO HOUSEWARES, INC.
MASSILLON, OHIO

April 1991

April 1991

Harold G. Byer
Project Manager

Stephen E. Schuyler, P.E.
Project Engineer

Timothy M. Farrell
Assistant Engineer

Prepared for:

AMERICAN HOME PRODUCTS
685 Third Avenue
New York, NY 10017-4085

Prepared by:

ROY F. WESTON, INC.
Weston Way

INTRODUCTION

The purpose of this Interim Remedial Measures (IRM) Report for Underground Storage Tanks (USTs) is to detail the status of all USTs present at the EKCO Housewares, Inc. (EKCO) facility in Massillon, Ohio. The EKCO plant is located at 359 State Avenue Extension N.W., Massillon, Ohio, 44648. This facility encompasses approximately 13 acres, starting 500 feet north of State Avenue Extension and 1,500 feet west of the Tuscarawas River in the northwest portion of Massillon, Stark County, Ohio. The property was previously owned by American Home Products Corporation (AHP) and sold in 1984. When the area surrounding the site is largely urban and industrial. The EKCO property is triangular in shape and is bordered on the north by Newman Creek, which flows eastward into the Tuscarawas River. Railroads border the facility on the west and east.

The facility is involved in the production of bakeware from metal pressing and coating operations. Site groundwater quality and elevated levels of volatile organic compounds (VOC) in site soils are being investigated under a RCRA corrective action program (RFI/CMS) proceeding under Section 3008(h) of RCRA. The corrective action program information is summarized in the RFI/CMS Work Plan (Roy F. Weston, Inc., 1990). Additional information can be found in the "Groundwater Quality Assessment Report" (Roy F. Weston, Inc., 1990).

SCOPE

The scope of work for the UST tightness testing followed that proposed in the IRM Work Plan for UST Management for EKCO Housewares, Inc. (Roy F. Weston, Inc., August 1990). The work plan was submitted by AHP to U.S. EPA Region 5. In the work plan, eight USTs were identified:

Table 1

Available UST Information

UST	Volume	Materials Stored	Latest Known Status
1	500	Gasoline	Abandoned - will be removed
2	2,500	Naphtha	In Use
3	4,000	Never Used	Never Used
4	3,000	Naphtha	In Use
5	4,000	Never Used	Never Used
6	Two 10,000	Fuel Oil	Abandoned -?
7	500	Kerosene	Removed*

* Removal occurred in 1988.

The Ohio State Fire Marshall received notification of these eight underground storage tanks on-site in 1986. The location of these tanks is shown in Figure 1.

The work plan was developed in response to a concern of U.S. EPA Region 5 that these tanks could have contributed to the VOC contamination detected on-site. The work plan was reviewed in our letter of 9 November 1990 to the U.S. EPA Region 5. At this time it was decided that several tanks would warrant investigation. In response Tank Nos. 2, 3, 4, and 5 were to be tested using the Acu-Test Leak Computer System.

On 20 March 1991, these USTs were leak tested. Tank tightness testing was performed by Midwest Tank Testing, Inc., a subcontractor for WESTON, using the Acu-Test Leak Computer System.

Tank No. 1, a 500 gallon capacity underground gasoline tank, was not tested. This tank is not in service and will be removed. An application for tank removal has been submitted to the Ohio State Fire Marshall by EKCO.

Tanks No. 6, two 10,000 gallon capacity underground fuel oil tanks, were not tested. These tanks have not been used since 1985. These tanks are exempt from the UST requirements because they were used for storing heating oil for consumptive use on the premises (40 CFR 280.12). Benzene, toluene, ethylbenzene, and xylene (BTEX) would be the major contaminants of concern if a release would occur. BTEX were not detected in the groundwater downgradient of these tanks in December 1988 (Groundwater Quality Assessment Report). A residual level of fuel is present in both tanks of approximately 210 gallons total. These tanks remain as a backup to the natural gas heating system and wold be used if the situation arose when heating oil could be used more economically.

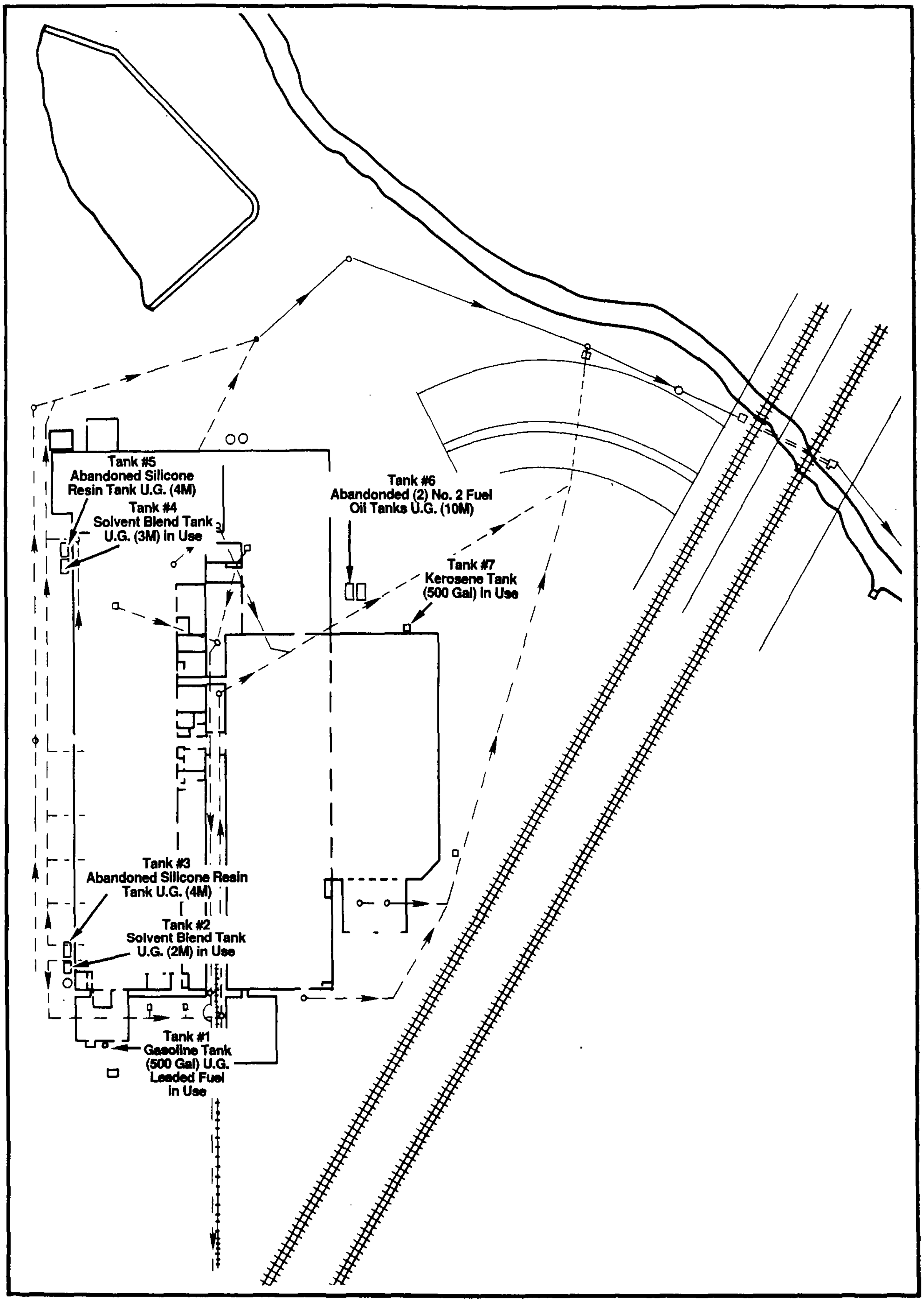


FIGURE 1 LOCATIONS OF UNDERGROUND STORAGE TANKS EKCO HOUSEWARES, INC., MASSILLON, OHIO

TEST METHODOLOGY

Tank Nos. 2 through 5 were leak tested using the Acu-Test Leak Computer System. This method is a temperature compensated, volumetric test capable of detecting a leak in a tank at a rate within 0.05 gal/hr. This system was the only one to meet and exceed all U.S. EPA standards and was ranked first in their evaluation study conducted at the Risk Reduction Laboratory in Edison, N.J.

The Acu-Test Leak Computer System, designed to function in an overfilled tank, measures changes in the product volume and product temperature in order to determine a volumetric flow rate. Changes in product volume are determined by measuring the amount of product that is added or removed to keep the product level in the fill tube constant. The amount of product added or removed is determined by the change in the weight (mass) of the supply of product maintained outside the tank, while a control loop using two optical detectors determines the time at which this addition or removal takes place.

To begin the test, the storage tank is filled until product stands in the fillpipe a minimum of 20 inches above the tank top, manway or highest piping to be included in all tests. An API hydrometer is used to measure the specific gravity of the product. This value is given to the computer for future calculations. A small measuring cylinder is filled with additional product and placed near the fillpipe. A level sensor is placed within the fillpipe and connected to a control box that activates either a solenoid valve or a pump, both of which are connected to the measuring cylinder. If the storage tank level rises, the level sensor causes the pump to remove liquid from the storage tank and pump it into the measuring cylinder. Conversely, a drop in product level results in an addition of product contained in the cylinder into the tank. The measuring cylinder is suspended from a load cell that is monitored by a computer. Any exchange of liquid with the storage tank is measured directly by the computer.

A temperature probe, which is inserted into the tank, has a series of seven thermistors located equally by volume across the diameter of the tank. The thermistors are connected to a sensitive Wheatstone Bridge, which permits an accurate measurement of the change in temperature of the thermistors. The bridge is calibrated to zero before the test begins, and a temperature of ±3°F range can be measured without readjustment of the bridge. The output of the Wheatstone Bridge is also monitored by the computer, and a temperature change can be detected with a precision of ±0.0001°F. Tank system changes are computed by using the coefficient of thermal expansion and the data collected by the system. The measured thermal volume changes are used to modify the amount of liquid to be added to or removed from the tank to establish a leak rate.

The top of the tank will usually be warmer or cooler than the bottom, depending on the temperature of the added product. The change in the average temperature with time is important in determining an accurate leak rate because such changes effect the amount of volumetric product expansion or contraction.

The computer samples cylinder weight and tank temperature changes approximately 250 times in a one minute cycle. At the end of each one minute cycle, the computer calculates the weight change from the previous cycle. This difference in weight is converted to volume, and along with the calculated volumetric change due to temperature variation, is used to calculated the leak rate for the cycle. The standard deviation of the average leak rate for the preceding 30 cycles is also calculated and displayed on the video screen. If the calculated average leak rate is 0.05 gal/hr or less at a confidence level of 99%, then the tank can be described as tight.

TANK PREPARATIONS

On 19 March 1991, the fill pipes for Tank Nos. 3 and 5 were disconnected by EKCO to permit access to the tanks. EKCO operating personnel stated that these tanks had never been placed in service and had not previously been used to store material of any kind. In order to confirm this, a swab sample was obtained from each tank. To obtain a swab sample from each tank, a swatch of cotton fabric was securely wrapped around the end of a wooden pole that was normally used to check the level in tanks. The fabric was secured to the pole with duct tape. An HNu reading of the clean swab was taken. Subsequently, the swab was inserted into the tank through the opening in the fill pipe. The bottom of the tank was wiped by manipulating the pole. The swab was then removed from the tank and a subsequent HNu reading was taken. The swab was visually inspected for signs of contamination. The results are summarized below:

Tank No.	Initial Reading (ppm)	Final Reading (ppm)	Appearance
3	0.2	0.4	dry w/rust
5	0.5	0.5	dry w/rust

These results confirmed that the two tanks were empty. Subsequently, approval was given by EKCO to fill both tanks with water. Water was added from a tank truck during the late morning and early afternoon of 19 March 1991.

Both solvent blend tanks (Nos. 2 and 4) were taken out of service and filled with solvent during the morning of 19 March 1991 from a tank truck. EKCO operating personnel then "dipped" the tanks to confirm that both were filled. Tank No. 4 was apparently 200 gallons short of being filled. Tank No. 2 was apparently filled.

Drop tubes on all tanks were removed 20 March 1991. This action affected the apparent level in each tank. In each case, additional material was added to raise the liquid level so that the fillpipe was partially filled as required for proper testing. Solvent blend was added to Tank Nos. 2 and 4 from drums by EKCO operating personnel. Tank No. 4 required approximately 4 drums of material whereas Tank No. 2 need 8 drums. Reason unknown. Possible explanations are an error in measurement, an air pocket caused by an obstructed vent line, or the unauthorized use of the material in the task for processing during the evening or night shifts.

RESULTS

Midwest Tank Test arrived on-site at approximately 9:30 a.m. 20 March 1991. Their personnel proceeded to inspect the tank preparations and to set up the tank testing equipment. The level sensor and temperature probe were all installed in the fill lines of each tank. All tests began that morning and were completed in the afternoon. All testing was performed in the presence of a U.S. EPA Region 5 contractor representative: Barry R. Nelson, Geologist, Metcalf & Eddy, Inc.

Acu-Test computer printouts of all four tests are attached in Appendix A. The following table matches the testing results with the appropriate tank.

Tank No.	Test No.
2	91032097.A38
3	91032094.B40
4	91032086.A36
5	91032087.B38

Testing of Tank Nos. 3 and 5 proceeded with little difficulty. The graphs showing leak rate versus time illustrate this, in both cases the leak rate at any time is within the reported accuracy of the test.

The two solvent blend tanks (Nos. 2 and 4) presented some problems for testing. The mass lost due to evaporation of the volatile solvent blend from Tank No. 4 caused initial difficulties in testing. Any loss from the tank is measured by the Acu-Test system as if it were a leak. Evaporative losses became apparent within the first hour of the test, as shown in the graph of leak rate versus time in the attached results for Test No. 91032097.A36. Insulating material was placed over the fillpipe and vent openings to reduce evaporative losses. Once evaporative losses were addressed with Tank No. 4, the test proceeded smoothly.

Tank No. 2, which also contained the volatile solvent blend, presented other testing difficulties so that evaporative losses were not readily apparent. In Tank No. 2, the temperature profile across the tank has not stabilized because of the additional 8 drums of solvent blend that had been added earlier in the morning. After the test had been run approximately 1.8 hours, the temperature profile did reach an equilibrium as is shown in the graph of leak rate versus time for Test No. 91032097.A38. Insulating material was placed around the vent opening to reduce evaporative losses. Once temperature equilibrium was reached, the system stabilized and the test proceeded to run smoothly.

All four tanks had leak rates less than or equal to 0.05 gal/hr. For Tank No. 2, the system tested tight at 38 inches above the top of the tank. Tank No. 3 tested tight at 40 inches above the top of the tank. Tank No. 4 tested tight at 36 inches and Tank No. 5 at 38 inches. A summary of the leak testing results is shown in the table below:

Tank No.	Test No.	Avg. Leak Rate (gal/hr)	99% Confidence (gal/hr)
2	91032097.A38	-0.03	0.00
3	91032094.B40	-0.01	0.01
4	91032086.A36	0.05	0.03
5	91032087.B38	0.00	0.00

CONCLUSIONS

All four tanks (Nos. 2 through 5) were determined not to be leaking, within the accuracy (0.05 gal/hr) of the test. Tanks Nos. 3 and 5 were confirmed as being empty.

APPENDIX A

TEST RESULTS

MIDWEST
TANK TESTING COMPANY

Customer: ECKO HOUSEWARES

MASSILLON, OH

Invoice# T-1-640

Date 3/20/91

FINAL TEST DATA

No.	Product	Capacity	Material	Diameter	Water	High Level	Low Level	Conclusion
1)	SOLV. BLD.	4,000	STEEL	64"	0"	-0.01GPH @ 38"	-	TIGHT
2)	WATER	4,000	STEEL	64"	-	-0.03GPH @ 40"	-	TIGHT
3)	SOLV. BLD.	3,000	STEEL	64"	-	0.05GPH @ 36"	-	TIGHT
4)	WATER	4,000	STEEL	64"	-	0.00GPH @ 38"	-	TIGHT

M - Manifolded System   Test Levels In Inches Taken From Tank Top Up

Product Lines - Pressure Test Results

SYSTEM		TYPE OF PUMP		Operating	Applied	Product	Test
No.	Product	Submersible	Suction	Pressure	Pressure	+/- GPH	Conclusion
1)	SOLV. BLD.		INDUSTRIAL		N/A		
2)	WATER		INDUSTRIAL		N/A		
3)	SOLV. BLD.		INDUSTRIAL		N/A		
4)	WATER		INDUSTRIAL		N/A		

Other Information: ALL PRODUCT LINES INCLUDED DURING FULL SYSTEM TESTING.

303 South Front Street • Columbus, Ohio 43215
614-224-4560 FAX 614-461-9572

IRM WORKPLAN FOR UST MANAGEMENT

FOR EKCO HOUSEWARES, INC.

MASSILLION, OHIO

AUGUST 1990

Prepared By:

ROY F. WESTON, INC.
Weston Way
West Chester, Pennsylvania 19380

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WESTON

SECTION 1

INTRODUCTION

The format and contents of this Interim Remedial Measures, (IRM) Workplan for Underground Storage Tanks (USTs) are to address the proper management and characterization of all USTs present at the EKCO Housewares, Inc. (EKCO), Massillon, Ohio, site.

1.1 SITE LOCATION

The EKCO facility is located at 359 State Avenue Extension N.W., Massillon, Ohio, 44648. This facility is located on approximately 13 acres, 500 feet north of State Avenue Extension and 1,500 feet west of the Tuscarawas River in the northwest portion of Massillon, Stark County, Ohio. Figure 1-1 shows the location of the facility on a 7.5-minute USGS Massillon quadrangle map of Stark County. The area surrounding the site is largely urban and industrial. The EKCO property is triangular in shape and bordered on the north by Newman Creek, which flows eastward into the Tuscarawas River. Railroads border the facility to the west and east.

1.2 SITE HISTORY

1.2.1 Facility Operations

The original part of the EKCO facility was built around 1900, and in 1945 the facility began producing aluminum cookware. In 1946, the facility started manufacturing pressure cookers and stainless steel cookware. In 1951, during the Korean conflict, the facility produced 90 mm and 105 mm cartridge cases for the U.S. Government. At present, the facility is engaged in the manufacture of bakeware from metal pressing and coating operations. Additional detail on previous site operations is available in Section 2 of the "Draft RCRA Closure Plan for EKCO Housewares, Inc.," (WESTON, 1988).

1.2.2 Current Environmental Studies

Since 1984 several investigations have been performed at EKCO to assess impact on groundwater quality and soils from facility operations. A Groundwater Reclamation Program was initiated by EKCO in 1986 in response to VOCs detected in a groundwater sample from production well W-1 during National Pollutant Discharge Elimination System (NPDES) permit renewal testing. In addition to the Groundwater Reclamation Program, site groundwater quality conditions and elevated levels of VOCs in site soils have been investigated under a RCRA corrective action program proceeding under Section 3008 (h) of RCRA. In particular, the EKCO surface impoundment soils are considered as part of the closure plan for the surface impoundment, being implemented in reference to 40 CFR Section 265.93. The RCRA corrective action program information is

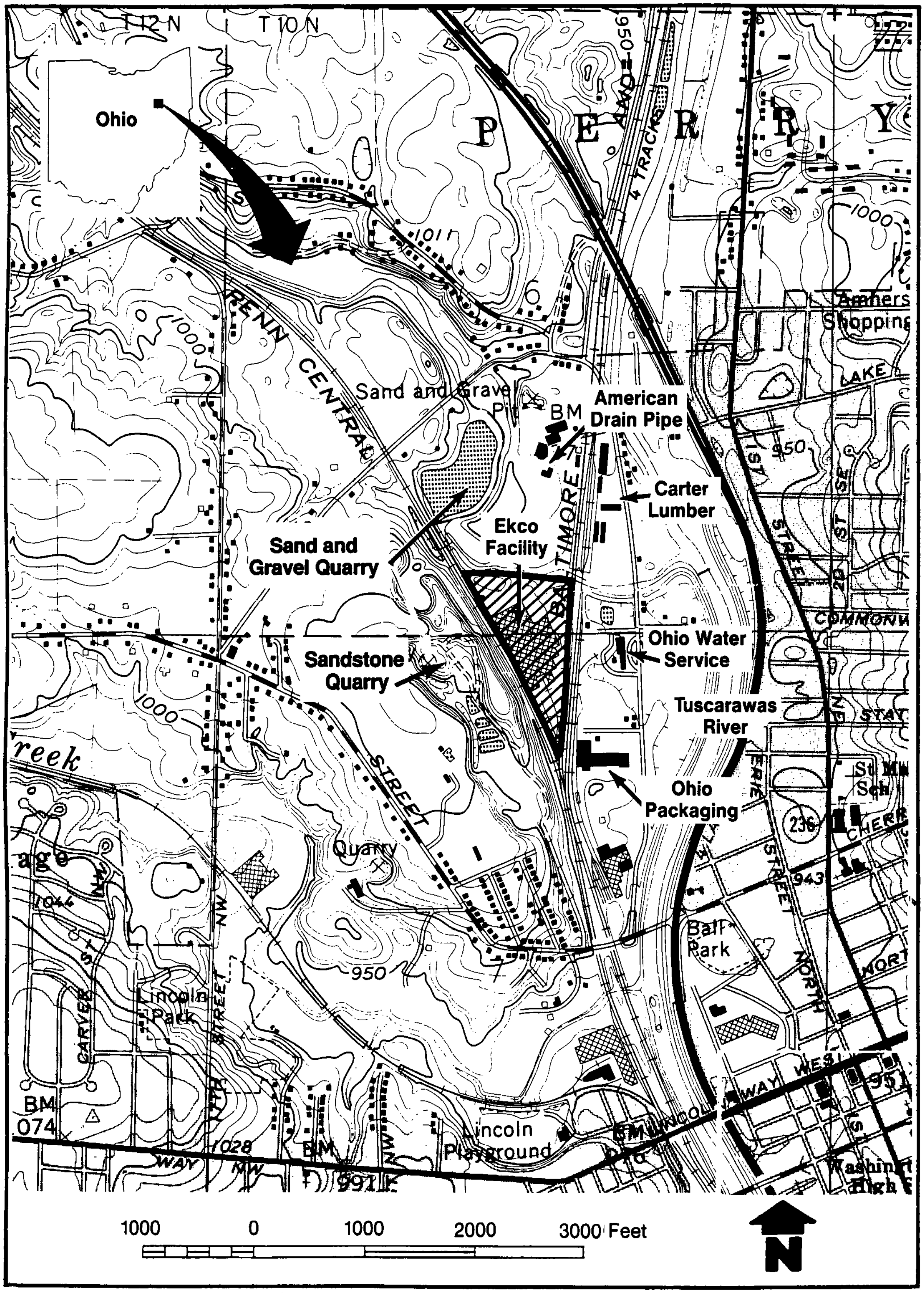

FIGURE 1-1 SITE LOCATION MAP
EKCO HOUSEWARES, INC., MASSILLON, OHIO
(Ref. 7.5 Minute Massillon Quad, Ohio, 1978)

summarized in a "Groundwater Quality Assessment Report," (WESTON, 1990) with the surface impoundment information contained in the "Draft RCRA Closure Plan for EKCO Housewares, Inc.," (WESTON, 1988). Also, an "RFI/CMS Work Plan," (WESTON, May 1990) has been prepared as a result of a consent agreement and negotiated scope of work between the past owners of EKCO and the U.S. Environmental Protection Agency (EPA) concerning the EKCO site.

1.3 CURRENT UST USAGE AND MANAGEMENT INFORMATION

In February 1986, a notification was given to the Ohio State Fire Marshal of seven USTs present at the EKCO site. This information sheet is contained in Appendix A and summarized in Table 1-1. The locations of these seven USTs are shown on Figure 1-2.

Of the seven USTs, only three were still in use as of February 1986: namely, one gasoline tank (UST number 1 on Figure 1-2) and two Naptha tanks (USTs number 2 and 4 on Figure 1-2). It should be noted that prior to the UST usage management review outlined in Subsection 2.1, the exact number and types of USTs to be included under this management workplan is not known.

TABLE 1-1

AVAILABLE UST INFORMATION*

UST	Volume	Materials Stored	Latest Known Status
1	500	Gasoline	Abandoned
2	2,500	Naphtha	In use
3	4,000	Never Used	Never used
4	3,000	Naphtha	In use
5	4,000	Never used	Never Used
6	Two 10,000	Fuel Oil	Abandoned
7	500	Kerosene	Removed**

*Based on information contained in Appendix A (as of February 1986) plus information from plant personnel.
**Removal occurred in 1988

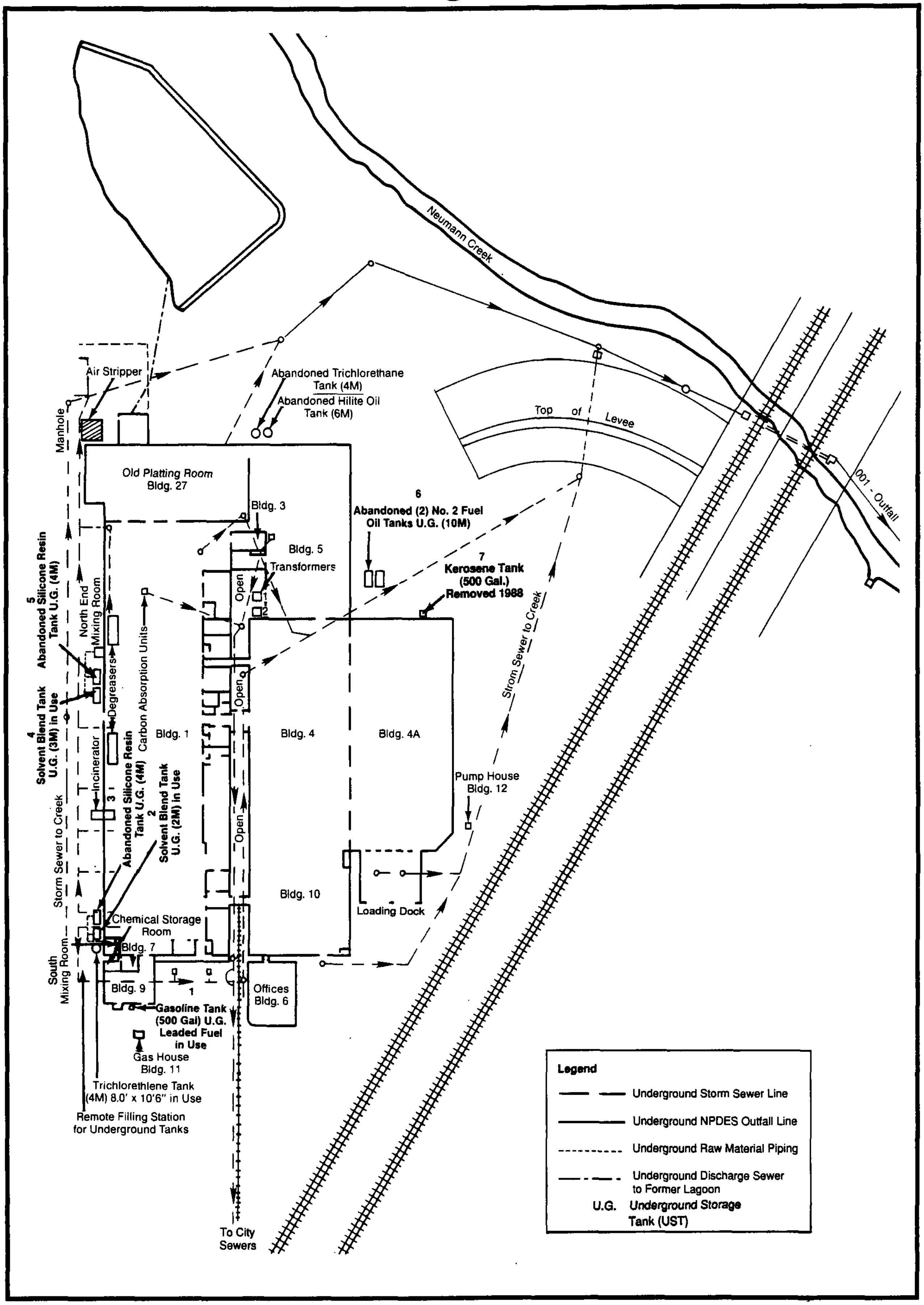

FIGURE 1-2 FORMER AND CURRENT UNDERGROUND STORAGE TANKS AND PIPING, AND ABOVE GROUND STORAGE TANKS

SECTION 2

SCOPE OF WORK

2.1 INVESTIGATION

Prior to field work for managing the USTs at EKCO, an investigation concerning the current and historical usage of all the USTs will be performed to provide information for upcoming management activities. Initial field work will consist of UST tightness testing and may, as necessary, include additional integrity testing methods to determine the potential of past releases from the USTs.

2.1.1 Tank Usage

Information regarding the past and present usage of the USTs at the EKCO site will be investigated to determine constituents of concern as well as operating practices. Information on the USTs such as design specifications (i.e. materials of construction, shell thickness, interior linings, etc.), as-built drawings, inspection schedules and maintenance records, as well as piping and ancillary equipment connections will be collected as available.

2.1.2 Tightness Testing

Tightness testing of all USTs at the EKCO site will be performed to meet the precision of the applicable federal U.S. EPA, state OEPA and local regulations. An initial investigation will be used to identify and recommend the most accurate, compatible, and technically proven tank tightness testing system for use in the EKCO UST Management program.

The initial assessment of available tank tightness testing methods will involve a general investigation based upon the methods' capability to adequately compensate for:

- Thermal variations.
- Water table effects.
- Structural tank deformation and geometry.
- Vapor pocket effects.
- Product evaporation.
- Tank inclination.
- Type of contained products.
- Wind effects.
- Operator error.

The Investigation will yield technically superior tank tightness testing methods such as:

- Acutest.
- AES/Brockman System II.

- EZY Check II.
- Petro Tite.
- Testronics System 90.
- VPLT Precision Leak Detection System.

that have the flexibility to accommodate the different testing conditions that could conceivably be encountered at the EKCO site. Specific tightness test and/or reports may be required to satisfy regulatory requirements.

2.1.3 Additional Integrity Assessment Methods

An additional Integrity Assessment Method, such as an internal UST inspection or ultrasonic testing coupled with a review of operating experience and performance history, may be performed to supplement data from the tightness testing integrity assessment. Prioritization for consideration of additional integrity assessment testing will be given to USTs that may have failed high level tightness testing but passed a low level tightness testing, possibly indicating external flanges, connections, or piping may have triggered the high level tightness testing failure. In this case, factors such as storage levels of contents and whether pressurized piping was part of the UST system could lessen the past potential of whether a leak in a non-pressurized filling pipe or pipe connection could have lead to a release from an UST system. When coupled with tank tightness testing, the additional integrity assessment testing should provide very high assurance of the knowledge of an USTs past potential for a release.

2.3 TANK MANAGEMENT

2.3.1 Tank Decision Process

Upon completion of UST tightness testing, the test results will be compared against established leak rate criteria. If, during the course of testing any of the scheduled UST systems, it becomes apparent that an UST will not meet the leakage criteria, the following action will be taken:

- The results of the test and the test procedures will be reviewed and confirmed by WESTON. If there is evidence or any suspicion that the proper setup or testing protocol was not followed, the deficient conditions will be immediately corrected and the test repeated to verify the generated data.

- If the tank tightness retest should verify that the actual leakage rate exceeds the criteria for the UST, then the U.S. EPA, OEPA, and local authorities will be notified with regard to the test data where required.

- If a leak is verified, the UST will be taken out of service, as applicable, and prepared for further evaluation (i.e. additional integrity assessment testing) and/or closure. The tank may be prepared for an internal inspection using the federal, state and/or local guidelines developed for an integrity inspection. An internal inspection may be conducted to assess if tank retrofitting or repair procedure could be performed to enable the tank system be brought back into service.

UST repairability can only be determined after the performance of an interior inspection to determine structural integrity. If repairs can be made, such repairs will be made as specified by applicable regulations and industry standards. In addition, the UST will be tightness-tested prior to returning it to service. If UST closure is warranted, the UST will be emptied of any remaining raw material and residual materials, cleaned, rendered free of all hazardous or flammable vapors, disconnected from any process or dispensing units, and closed according to all required provisions either by inplace closure or by removal.

2.3.2 Tank Closure

2.3.2.1 Overview of Closure Approach

The overall approach to UST closures is to provide a carefully controlled program under which UST removal activities are planned, safely executed, and verified. A closure plan will be prepared for the USTs that are to be permanently removed from service. The plan will describe procedures for inventory removal, cleaning of the UST and ancillary equipment, inplace closure or removal of the UST system, and management of any wastes generated or impacted soils that were necessarily excavated as part of the UST remediation.

The closure activities will interface with four other ongoing environmental programs at EKCO. These additional ongoing programs are described in Subsection 1.2.2

2.3.2.2 Overview of the UST Systems Closure Plan

The closure plan will designate the specific actions or procedures that must be followed to clean and close the USTs. Closure will include decontaminating the USTs, characterizing excavated materials, inplace closure or removal of the USTs, and documentation of closure activities. The closure plan is not intended to be a final remedial action plan. The scope of the closure plan will be to close the USTs via inplace closure or removal, manage impacted soils that were necessarily excavated in the closure process, and demonstrate whether additional remedial actions are required in accordance with ongoing environmental programs. The extent of any remaining impacted soils, the selection of a cleanup method, and the establishment of target levels are not within the scope of this closure plan but will be addressed as the RFI/CMS progresses along the normal path.

2.3.3 Safety Requirements

A health and safety plan (HASP) will be developed to contain health and safety information specific to the USTs being removed. The HASP will include a discussion of the nature of the hazards associated with each chemical expected to be encountered, including physiological effects and symptoms of exposure. The HASP will also include a discussion of the physical hazards involved in closing the UST systems. The HASP will designate the anticipated level of protection that will be required to accomplish the work, and provisions for moving to a higher or lower level of protection. Portions of the presently approved HASP for site activity will be utilized as part of this effort.

2.3.4 Excavated Soil Characterization

All soils excavated under the UST closure activities will be subject to a procedure for characterization. Protocols will be contained in the UST closure plan that will describe the sampling and analysis procedures for each step of the field characterization method. The field characterization method will be used to differentiate between soils that may be returned to the original work space to await further evaluation, and soils that will be stockpiled onsite to be treated or disposed of according to applicable solid or hazardous waste protocol.

2.4 CLOSURE CERTIFICATION

All work will be observed by EKCO personnel or their representative. As appropriate, a Professional Engineer registered in the State of Ohio will certify that an UST system has been removed according to the closure plan. All closure activities will be documented.

SECTION 3

SCHEDULE

A schedule of planned testing and closure activities is given in Table 3-1. The tentative start date of the actual closure is scheduled as 180 days after submittal of the UST closure plan.

TABLE 3-1

SCHEDULE OF PLANNED TESTING AND CLOSURE ACTIVITIES

		Weeks from Approval
1.	Mobilization	1
2.	Current UST Usage Management Review	2
3.	UST Tightness Testing	4
4.	Evaluation of UST Tightness Data	6
5.	Submission of UST Closure Plan	12

APPENDIX A:

UST INFORMATION AS OF 2/10/86

1. Name and address of the facility (PRINT OR TYPE IN ALL SPACES)

Ekco Housewares, Inc.
359 State Ave. Ext., N.W.
Massillon, Ohio 44648

...facility, if different from location address.

P. O. Box 560

... phone number)

Ekco Housewares, Inc.
359 State Ave. Ext. N.W.
P. O. Box 560
Massillon, Ohio 44648
(216) 832-5026

phone number)

Leo Hahn

(216) 832-5026

5. Type of owner (Mark "X" in appropriate box)

☒ Private ☐ Government

6. Remarks

Complete the following section(s) to the best of your knowledge using the examples provided as guidance. Check appropriate boxes and fill in blanks where applicable. If you need more space, photocopy this page or use a continuation sheet. If you do not know the answer, enter "unknown."

(7H, 7I & 7J must be completed for tanks no longer in use.)

7. All tanks currently in use or that will be brought into use and all tanks no longer in use.

A. Tank No	B. Age (yrs.)	C. Total capacity (gal)	D. Material of construction: Steel	Fiberglass reinforced plastic	Other (specify)	E. Internal protection: Lined	Unlined	F. External protection: Coated	Wrapped	Cathodic protection	Other (specify)	G. Substance type: Gasoline	Diesel	Kerosene	Hazardous substance name	UN #	H. Date of last use: Month	Year	I. Estimated Quantity (gal)	J. X if tank is no longer in use
Example	5	10,000		X			X	X						X						
Example	8	8,000	X				X			X					Trichloroethylene	1710				
Example	26	8,000	X				X	X					X				6	75	120	X
1	5	500	X				X	X				X				1203				
2	6	2,500	X				X	X							Naphtha	1993				
3	2	4,000	X				X	X							Never In Use	NA				
4	2	3,000	X				X	X							Naphtha	1993				
5	2	4,000	X				X	X							Never In Use	NA				
6	12	2 X 10,000	X				X	X							Fuel Oil	NA	8	85	210	X
7	25	500	X				X	X						X			3	85	15	X

8. Certification

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete.

James O. Epps 2-10-86

James O. Epps

A. Name, SSN and Official Title of owner or owner's authorized representative (type or print)

Thomas J. Shingleton, Plant Manager

B. Signature

Thomas J. Shingleton

C. Date signed

2/10/86

[redacted] This information is required by Section 90[redacted] the Fed[redacted]esource[redacted]rvation[redacted]ecove[redacted] as am[redacted]. (P.[redacted]6)

ATTACHMENT I

FINAL

INTERIM MEASURES REPORT
FOR EKCO HOUSEWARES, INC.
MASSILLON, OHIO

Feb 8 1988

INTERIM MEASURES PLAN FOR
RECOMMENDED ADDITIONAL
INTERIM MEASURES

8 February 1988

Prepared By:

ROY F. WESTON, INC.
Weston WAy
West Chester, Pennsylvania 19380

FINAL
ATTACHMENT I

DRAFT

INTERIM MEASURES REPORT
FOR EKCO HOUSEWARES, INC.
MASSILLON, OHIO

INTERIM MEASURES PLAN FOR
RECOMMENDED ADDITIONAL
INTERIM MEASURES

M. N. Bhatla, Ph.D., P.E.
Project Director

Harold G. Byer
Project Manager

Richard C. Johnson, P.G.
Sr. Project Geologist

8 February 1988

Prepared By:

ROY F. WESTON, INC.
Weston Way
West Chester, Pennsylvania 19380

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SECTION 1

INTRODUCTION

1.1 INTERIM ACTIVITIES: PURPOSE AND SCOPE OF WORK

The purpose of the interim activities was to address immediate concerns expressed by U.S. EPA, Region V, relating to potential impacts of contaminants in ground water on area water supplies. This information will also be used to develop a ground water assessment plan as a part of the closure plan for the Evaporation Lagoon facility (particularly, in reference to 40 CFR Section 265.93).

The tasks performed in the interim activities included:

- Collecting and analyzing a water sample from the abandoned Ohio Water Service Company Well No. 4 for Target Compound List (TCL) volatile organics.

- Reviewing area geology and ground water conditions and estimating the ground water flow directions within a one-mile radius of the facility based on the available geologic and hydrologic information.

- Determining local ground water flow conditions and directions beneath the site.

- Conducting a ground water utilization survey which identified and located potable and commercial water wells within a one-mile radius from the plants' facility.

- Sampling of plant monitoring and production wells for Target Compound List (TCL) volatile organics.

The first three tasks were performed during the weeks of 31 August 1987 and 7 September 1987. The plant monitoring and production wells were sampled during the week of 21 September. These activities are further described in Section 2.

1.2 PLANT LOCATION

The EKCO Housewares, Inc. facility occupies approximately 13 acres on 3rd Street NW in the town of Massillon, Stark

County, Ohio. Figure 1 is a map of a portion of Stark County locating the site. The area surrounding the site is largely urban and industrial. The EKCO property is approximately 1,500 feet west of the Tuscarawas River and is bordered by Newman Creek to the north and Penn Central and Baltimore and Ohio Railroads to the west and east, respectively. Figure 2 illustrates the extent of the EKCO Housewares Property.

1.3 PLANT HISTORY

Since 1945, the Massillon EKCO Housewares facility has been manufacturing aluminum and stainless steel cookware. By 1951, with the United States involvement in the Korean Conflict, the plant was manufacturing 90mm and 105mm shell casings for the military. During this time, increase in production necessitated the drilling of two production wells (W-1 and W-2) at the facility. In approximately 1953, an evaporation lagoon was constructed along the northern property boundary adjacent to Newman Creek. Sludge from the waste treatment of the military production was discharged to the lagoon.

In 1969, with the development of new regulations and permit requirements, the evaporation lagoon was approved and permitted by the State of Ohio to discharge liquid waste products associated with plant activities. These waste products have included:

- Deionizers from copper plating operations (hydrochloric acid and sodium hydroxide).
- Washings and waste material from manufacturing porcelain-teflon coated aluminum cookware (aluminum frit, various coloring inorganics oxides, lead, cadmium, selenium, cobalt, and toluene).
- Alkaline washer fluids to clean aluminum cookware.

Due to the discontinued manufacturing of aluminum porcelain cookware, the lagoon was not used after 1977 except for housing degreaser filter water in 1980 to mid-1984.

In March 1984, when the plant applied for a renewal of a NPDES Permit, the law required the analysis of on-site well water for volatile organic compounds (VOCs). The analysis

WESTON
MANAGERS DESIGNERS CONSULTANTS

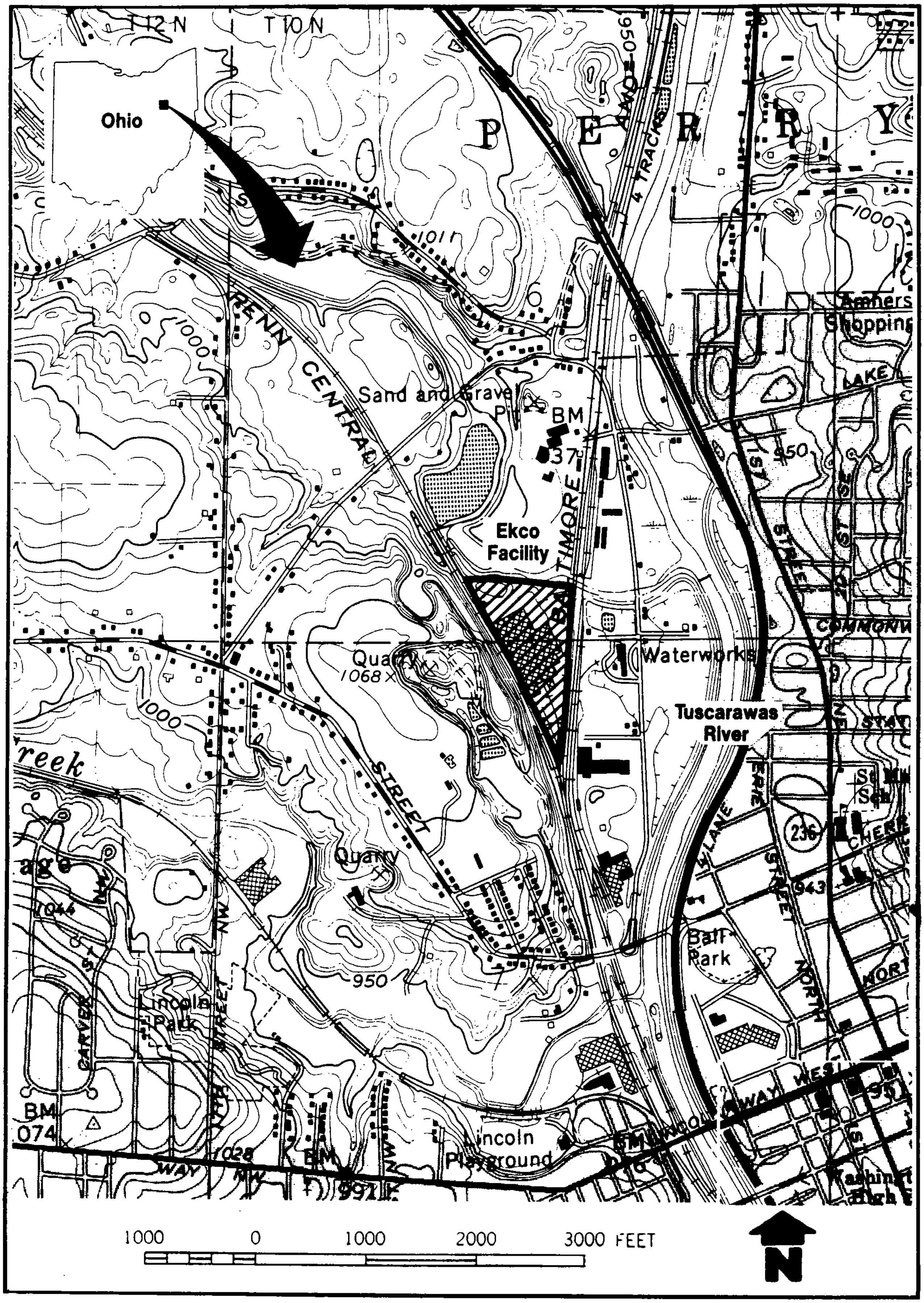


FIGURE 1 SITE LOCATION MAP
EKCO HOUSEWARES, INC., MASSILLON, OHIO
(Ref. 7.5 Minute Massillon Quad, Ohio, 1978)

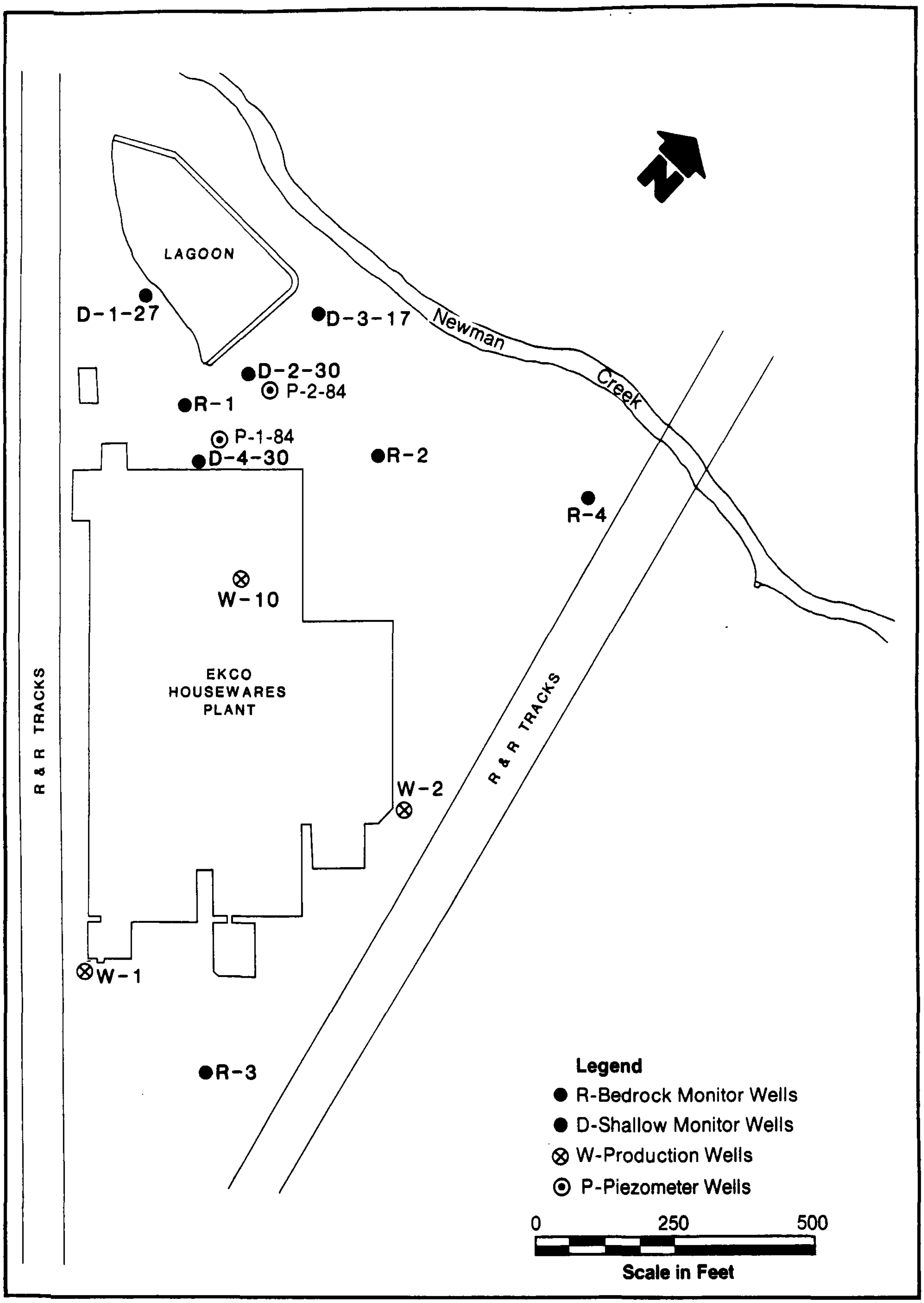


FIGURE 2 SITE DIAGRAM WITH LOCATIONS OF PRODUCTION AND MONITORING WELLS EKCO HOUSEWARES, INC., MASSILLON, OHIO

indicated 1,1,1 Trichloroethane (TCA) and Trichloroethylene (TCE). TCA and TCE have historically been used at the plant to clean both stainless steel cookware and metal bakeware.

In 1984, with the discovery of TCA and TCE in the ground water beneath the plant, four 6-inch bedrock monitoring wells and two 1 1/4-inch piezometers which were drilled into the overburden were installed at the site. The locations of these wells can be seen on Figure 2. The monitoring wells were sampled along with the three on-site plant production wells (W-1, W-2 and W-10) and a municipal production well located approximately 1,000 feet east of the plant (Ohio Water Service Company Well No. 4). Several volatile organic compounds on the EPA's Target Compounds List (TCL) were detected including TCE, TCA, vinyl chloride and dichloroethylene. The municipal well was subsequently taken out of service and converted to a 5-inch monitoring well. Four additional 1 1/2-inch monitoring wells were later installed into the overburden around the lagoon in January 1987.

Since early 1985, EKCO, with approval from the Ohio EPA, has conducted a ground water recovery program which includes continual pumping of ground water from two production wells and treatment of that water at an on-site air stripper. Some of this water is used in plant processes. Discharge is ultimately to Newman Creek under a NPDES permit. In their letter of 23 April 1985, Ohio EPA outlined reporting requirements for production well monitoring, air stripper emissions monitoring, monitor well sampling, water level monitoring, and city well sampling. The agency also stated that the cleanup of contaminated soils (outside of the lagoon) through natural flushing of the soils and eventual recovery of ground water is a "viable approach," if effective.

WESTON was retained to design and implement a ground water assessment plan for the Massillon EKCO site. The assessment would include an evaluation of contaminant migration and the immediate risk of off-site migration to downgradient wells.

SECTION 2

INTERIM ACTIVITIES

Interim activities were conducted at the Massillon EKCO site to satisfy the interim objectives as stated in Section 1. The five work tasks are described in the following subsections.

2.1 GROUND WATER SAMPLING OF OHIO WATER SERVICE COMPANY WELL NO. 4

A ground water sample was collected from Ohio Water Service Company abandoned Well No. 4 on 3 September 1987 and was analyzed for TCL volatile organic compounds.

Prior to sampling, specific information on well construction, was obtained from the Ohio Water Service Company. Originally, the well was 165 feet deep and the diameter and length of the screen was 18 inches and 40 feet, respectively. After abandonment, the well was completed as a 5-inch monitoring well cased to 140 feet and screened from 140 to 150 feet below ground surface. The annulus between the original and new screens was completely packed with pea gravel.

The specific procedures used to sample the well were as follows:

- The submersible pump used to purge the well was pre-cleaned, prior to its arrival on-site, by pumping an Alconox wash followed by two potable water rinses through the unit. On the day of sampling, the unit received an additional tap water rinse followed by a deionized water rinse.

- The depth to water was measured (18.75 feet below top of casing) and the volume of water in the well was determined for the purpose of purging.

- The pump was lowered to a depth of 50 feet below top of casing so as to allow for drawdown during purging. The well was pumped for 45 minutes at a rate of 10 gallons per minute.

- Since a pumping rate of 10 gallons per minute did not produce a significant drawdown, the pump was raised to a depth of 20 feet below the top of the casing. This insured complete purging of the well by inducing water flow from the screen to pump intake level.

- The well was pumped for a total of 5 hours giving a total evacuation volume of 3,000 gallons (3.8 well volumes).

- Prior to sampling, a Teflon bailer was decontaminated using the same decontamination procedures as outlined for the submersible pump.

- Clean, unused, polypropylene rope was tied to the end of the bailer and both were inserted into the well.

- The following five samples for volatile organic analysis were collected:

  #1 - well sample
  #2 - duplicate well sample
  #3 - field blank
  #4 - matrix spike
  #5 - matrix spike duplicate

- A trip blank was prepared and provided by WESTON Analytical Laboratories. The blank traveled with the glassware to the site and with the samples during shipment.

- Once collected and after insuring that no air bubbles were present, the samples were immediately placed on ice and entered on a chain of custody form to await shipment. The samples and chain of custody form were packaged according to D.O.T. regulations and shipped via Federal Express to WESTON Analytics, Lionville, Pennsylvania.

2.2 REGIONAL GROUND WATER FLOW CONDITIONS

Regional ground water flow directions were determined by obtaining references from the Ohio Department of Natural Resources. These references include publications of the following:

- Regional geology and geologic maps.

- Underground water resources for the basins and water sheds in the Massillon area.
- Water quality and use in Ohio.
- Surface drainage maps of Ohio.
- Soil survey for Stark County.
- Low flow frequencies and storage requirements for Ohio streams.
- Ground water levels in Ohio.

2.3 LOCAL GROUND WATER FLOW CONDITIONS

The ground water flow direction beneath the site was determined by:

- Identifying the relative elevation at the top of the inner casing of all on-site production and monitoring wells.
- Measuring the depth to water from the top of the inner casing.
- Calculating the elevation of the ground water beneath the site.
- Contouring points of equal elevation of the ground water beneath the site.

2.4 GROUND WATER USE WITHIN THE STUDY AREA

Potable water wells and industrial-use wells within a one-mile radius of the site were identified with the help of:

- Well records filed at the Ohio Department of Natural Resources for the permitted wells within the study area.
- An interview with a local well drilling firm. If available, well logs, well construction diagrams, and well locations for all the wells in the study area that the drilling firm had installed were obtained.

- o A visit to the Ohio Water Service Company which revealed locations of residences who do not use public water within a one-mile radius of the site. The water company also provided information on the municipal, industrial and commercial wells within a one-mile radius of the site.

- o A 1985 aerial photograph. Residential houses surrounding the site were located from the photograph to a county tax map. The map was provided to the Ohio Water Service for confirmation of the presences or absence of domestic wells at the specified locations.

2.5 MONITORING AND PRODUCTION WELL SAMPLING ON THE EKCO PROPERTY

The monitoring wells (R-1 thru R-4, D-1-27, D-2-30, D-3-17, D-4-30, W-1 and W-10) at the Massillion EKCO site were sampled on 23 September 1987 in order to obtain baseline information for the development of the Ground Water Assessment Plan. The ground water samples were analyzed for full TCL parameters.

The specific procedures used to sample wells D-1-27 thru D-4-30 were as follows:

- o The depth to water was measured and the volume of water in the wells was determined for the purpose of purging.

- o The dedicated bailers in the wells were used to evacuate three well volumes.

- o Purge water was place in an on-site tanker.

- o The wells were allowed to recover overnight.

- o Samples were taken directly from the dedicated bailers.

The specific procedures used to sample wells R-1 thru R-4 were as follows:

- o The depth to water was measured and the volume of water in the wells was determined for the propose of purging.

- The dedicated pumps in the wells were turned on and three well volumes were evacuated.
- Purge water was discharged directly into an on-site tanker.
- The wells were allowed to recover overnight.
- Samples were taken directly from the pump outlets.

The specific procedures used to sample production wells W-1 and W-10 were as follows:

- The depth to water was measured.
- Since the wells are continuously running, no purging was necessary.
- Samples were taken directly from the well tap.

SECTION 3

RESULTS OF THE INTERIM ACTIVITIES

3.1 RESULTS OF OHIO WATER SERVICE COMPANY WELL NO. 4 GROUND WATER SAMPLE

The results of the sample collected on 3 September 1987 from the Ohio Water Services Company well No. 4 are shown in Table 1. This table also contains the QA/QC sample results (the sample duplicate, matrix spike, matrix spike duplicate, field blank and trip blank, respectively). The quantification of volatiles was by the purge and trap GC-Hall detection method as described in EPA Method 601.

3.2 REGIONAL PHYSIOGRAPHY, SOILS, GEOLOGY AND HYDROLOGY

Stark County lies within the Muskingum River basin and within the Allegheny Plateau province in its entirety. The line of glaciation marking the farthest southward advance of the ice sheets extends to the southern edges of the county. The glaciated area is generally gently rolling with some flat topography.

The soils in the area belong to the Chili-Wheeling-Shoal association which formed in silty deposits underlain by sands and gravels. They are light colored and well drained soils and are nearly level to gently sloping. Just west of the site lies relatively thick, permeable glacial deposits of sand and gravel along the Tuscarawas River. Yields of more than 1,000 gallons per minute have been developed from wells installed in these deposits.

The bedrock beneath the area consists of interbedded sandstones and shales belonging to the Pottsville group of Pennsylvanian age. The bedrock dips generally to the southeast at about 20 to 40 feet per mile. Yields of as much as 500 gallons per minute have been reported from this bedrock, however, regional yield seldom exceeds 15 gallons per minute.

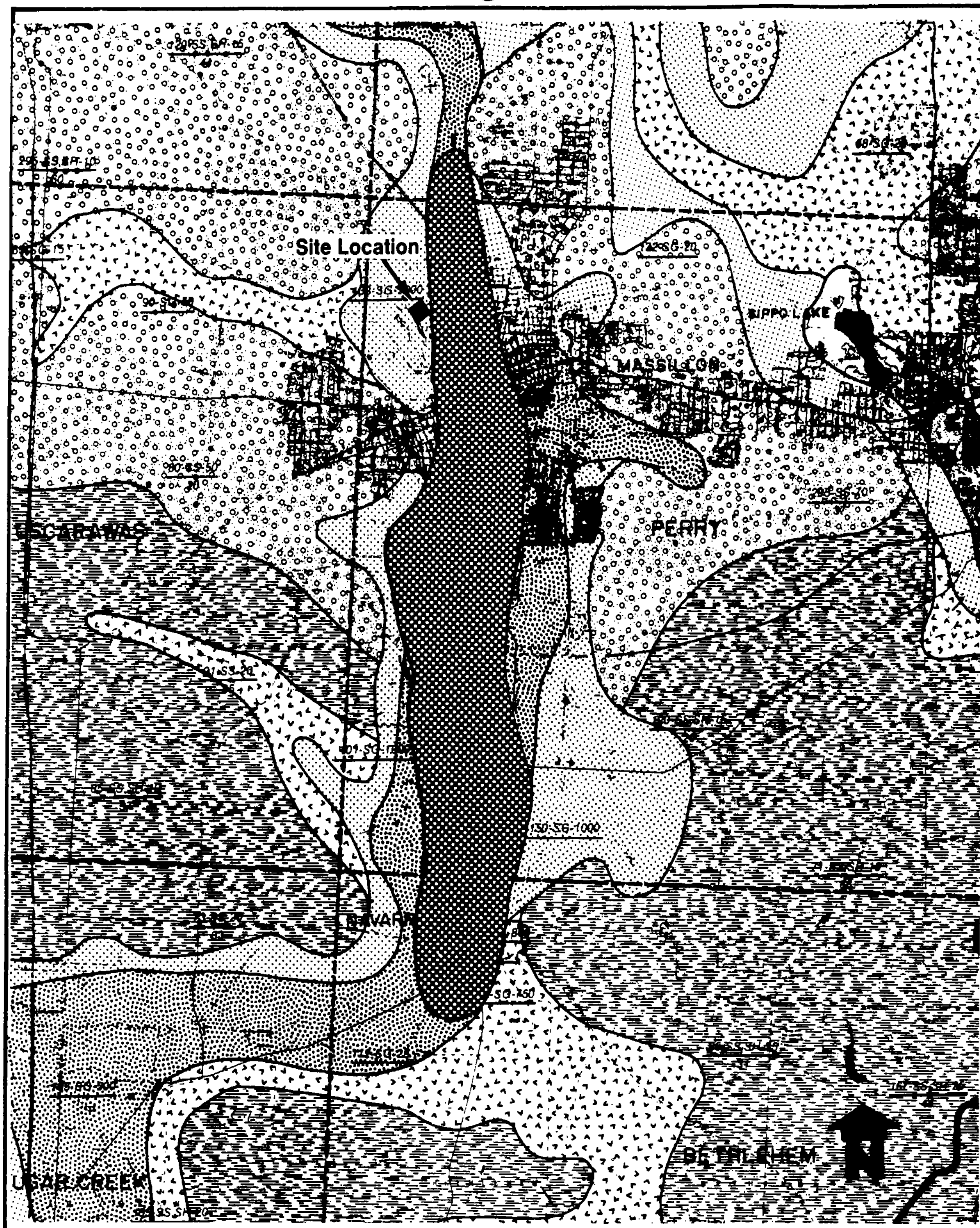
Figure 3 illustrates the water resources in the area surrounding the site. Since bedrock dips toward the southeast and the Tuscarawas River lies approximately 1,500 feet southeast of the site, the regional ground water flow

TABLE 1

RESULTS OF 3 SEPTEMBER 1987 OHIO WATER SERVICE COMPANY
WELL NO. 4 GROUND WATER SAMPLE
(ug/l)

	WELL #4	WELL #4 DUP	WELL #4 MATRIX SPIKE	WELL #4 MATRIX SPIKE DUP	FIELD BLANK	TRIP BLANK
Benzene	4.6	4.7	90%	97%	---	---
Chloroform	---	---	---	---	3.2	3.1
Tetrachloroethene	---	---	1.8	1.8	---	---
Trichlorofluoromethane	1.2	1.3	1.2	1.2	1.5	1.3
Vinyl Chloride	2.5	2.9	2.3	2.5	---	---

--- = Analyzed, not detected



Legend

- Permeable Sand and Gravel Deposits in Deep Buried Valleys. Can Yield More Than 500 gpm.
- Valley Fill Containing Sand and Gravel Deposits of Limited Thickness and Extent. Can Yield 10-30 gpm.
- Permeable Sand and Gravel Deposits Not Traversed by Major Streams. Can Yield 100-500 gpm.
- Interbedded and Interlensing Sand, Gravel, Silt and Clay. Can Yield 25-100 gpm.
- Sandstones of the Pottsville Group. Can Yield 25-100 gpm.
- Sandstones and Sandy Shales. Can Yield 10-30 gpm.

Scale in Miles

0 1 2 3 4

(Source: **Groundwater Resources of Stark County,** Alfred C. Walker, Ohio Department of Natural Resources.)

FIGURE 3 GROUNDWATER RESOURCES OF MASSILLON, OHIO direction is to the southeast towards the Tuscarawas River. Ground water that discharges from the bedrock aquifers to the buried glacial sediments would have a southern flow component, approximately parallel to the flow of the Tuscarawas River.

3.3 LOCAL GROUND WATER FLOW DIRECTION

The water level data indicates that the ground water beneath the site lies in two distinct zones;

- o The ground water piezometric surface in Zone 1 occurs from 8 to 26 feet below the ground surface in the wells installed in the unconsolidated sediments.

- o The ground water piezometric surface in Zone 2 occurs from 22 to 52 feet below the ground surface in the wells installed in the Pottsville Sandstone.

Analysis of the ground water elevations in the shallower wells (Zone 1) indicates that the ground water flow direction is to the southeast, parallel to Newman Creek and towards the Tuscarawas River.

Figure 4 was generated using the ground water elevations for the wells installed in the Pottsville Sandstone. From this, it is difficult to determine the natural ground water flow direction because the major withdraws from W-1 and W-10 are causing a cone of depression and the ground water to flow radially toward the center of the site (to W-10).

3.4 IDENTIFICATION AND LOCATION OF GROUND WATER SUPPLY WELLS WITHIN A ONE-MILE RADIUS OF THE SITE

The known or inferred locations of potable water wells within a one-mile radius of the site were identified and are located in Figure 5. Included in this figure are areas where domestic wells are most likely to be present, and locations of commercial, and municipal wells. Written opinion concerning the absence of potable wells lying between the river and the areas just south, southeast and east of the site was obtained from the Ohio Water Service Company (see Attachment A).

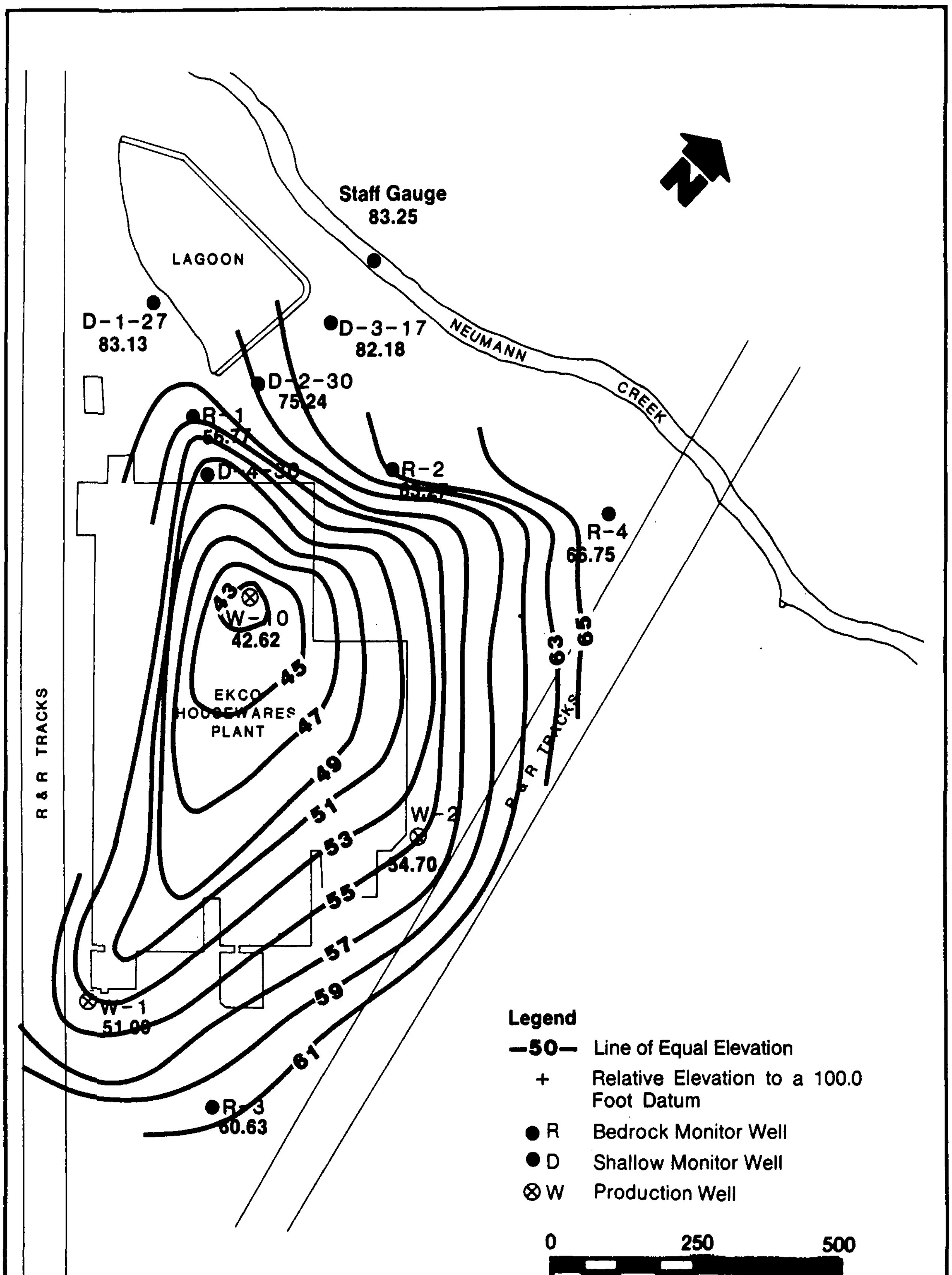


FIGURE 4 CONTOUR OF BEDROCK GROUNDWATER ELEVATIONS +
EKCO HOUSEWARES, INC., MASSILLON, OHIO

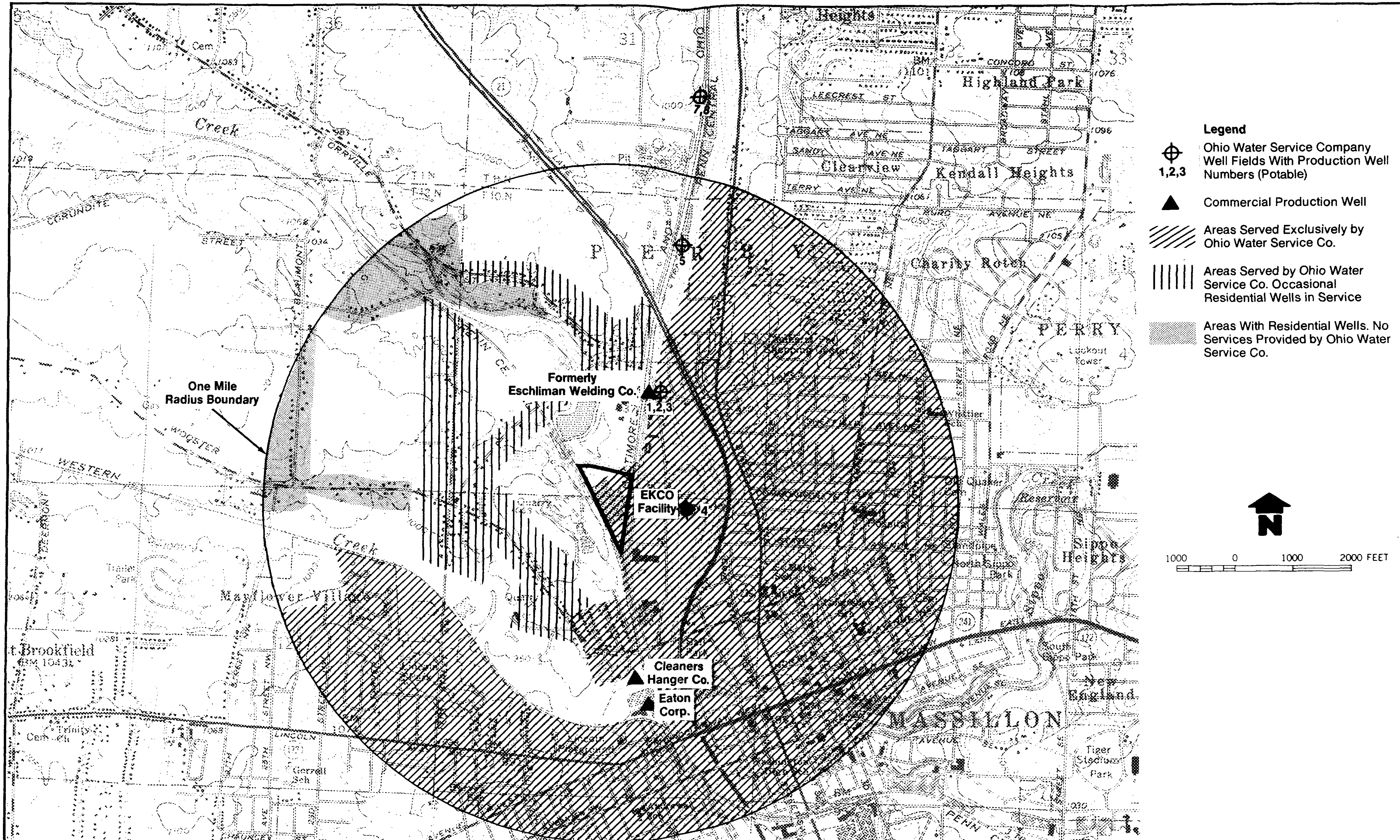


FIGURE 5 **WATER SUPPLY MAP WITHIN ONE MILE RADIUS OF THE EKCO FACILITY BOUNDARY**

(Ref. 7.5 Minute Massillon Quad, Ohio, 1978)

Since ground water is generally flowing to the southeast, it can be seen from Figure 4 that only two commercial wells lying approximately 2500 feet south of the site are potential receptions of contamination migration.

When comparing Figures 3 and 5, it can be seen that the Ohio Water Service production wells draw from a highly permeable sand and gravel aquifer and have the capability of yielding over 500 gallons per minute. The locations of the downgradient commercial production wells directly overlie interbedded and interlensing, less permeable sands, gravels, silts and clays which yield only 25 to 100 gallons per minute. Finally, the areas containing residential wells overlie the sandstones of the Pottsville group and valley fill sand and gravel deposits. These latter water bearing units have the capacity of yielding between 10 and 100 gallons of water per minute.

3.5 RESULTS OF PRODUCTION AND MONITORING WELL SAMPLES ON THE EKCO PROPERTY

The results of the 23 September 1987 plant production and monitoring well sampling can be seen in Table 2. Figure 6 illustrates the concentrations of total volatile organic compounds, TCE and vinyl chloride in the corresponding wells.

TABLE 2

RESULTS OF 23 SEPTEMBER 1987 PRODUCTION AND MONITORING WELL
SAMPLES AT THE EKCO SITE
(ug/l)

	R-1	R-2	R-3	R-4	R-5	W-1	W-10	W-10D	D-1-2	D-2-30	D-3-17	D-4-30
Acetone		12						110				26
2-Butanone												95
Carbon Disulfide												1J
Carbon Tetrachloride												220
Chloroform												13
Chloromethane												2J
1,1-Dichloroethane	15		4J			130	180	160	4J	97	160	8400
1,2-Dichloroethane		75						5				100
1,1-Dichloroethene	6	11				16	160	110		5	3J	20000
Methylene Chloride	3JB	3JB	4JB	4JB	3JB	3JB	4JB	5B	3JB	3JB	3JB	19B
Toluene							1J	2J				
Trans-1,2-Dichloroethene	65	200				17	110	84	4J	100	54	210
1,1,1-Trichloroethane	84	41	2J			100	3800	4500	18	9	10	180000
Trichloroethene	270	1100	2J			140	1700	2100	75B	36	16	57000
1,1,2 Trichloroethane												130
Vinyl Chloride	19	45					7J			86	110	10

J = Indicates an estimated value
B = Indicates that the analyte was detected in the blank and sample

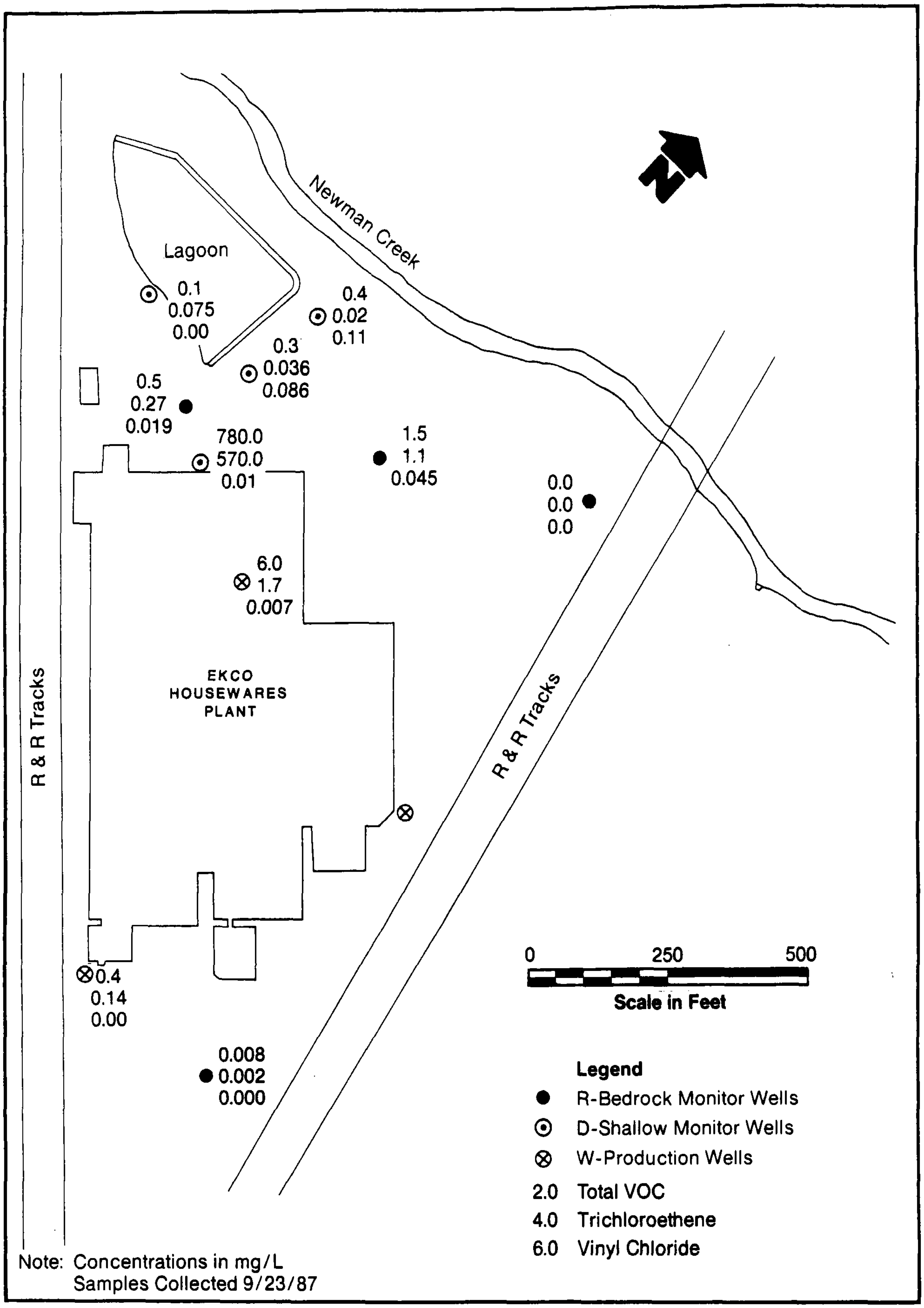


FIGURE 6 VOLATILE ORGANIC COMPOUNDS (VOC) GROUNDWATER SAMPLING ANALYTICAL RESULTS EKCO HOUSEWARES, INC., MASSILLON, OHIO

SECTION 4

CONCLUSIONS AND RECOMMENDATIONS

The major purpose of the Interim Report is to determine whether an immediate risk to human health exists because of known or potential ground water contamination associated with the EKCO plant. Based on the results presented in the previous section the following conclusions are made:

- o HSL volatile organic compounds were identified beneath the facility. No other HSL compounds were found in elevated concentrations in the on-site wells.

- o The sample from Ohio Water Service Well Number 4 contained low concentrations (<10 ug/l) of volatile organic vinyl chloride, trichloroflouromethane and benzene. The source of these compounds is not presently known.

- o No present ground water use for potable supply was identified within one mile downgradient of the EKCO facility. However, the upgradient Ohio water service wells 1, 2, 3 have recently increased total withdrawal to as much as 6.5 mgd.

- o Present pumping of W-10 at the EKCO plant is providing at least partial containment of the plume. The degree of contamination is not known.

Based on these findings, hydraulic containment will be maximized as an interim measure prior to the execution of the full ground water assessment. EKCO has determined that it is possible to increase pumping at W-10 which in now pumping at a rate much lower than stripper capacity. The well has been tested to determine what increased capacity it can maintain. Installation of a 400 gpm pump is underway by EKCO. Completion is expected by the end of ~~February~~ APRIL, 1988.

Three piezometers will be installed to monitor water levels and determine the hydraulic gradient in the unconsolidated sediments between the plant and Ohio Water Service Wells 1, 2, and 3. Installation of these piezometers is dependent upon securing access to the necessary adjacent property. Certified letters have been sent to the property owners requesting access. No positive responses have yet been received.

Piezometers will be constructed of 2-inch diameter screen and riser with 20 feet of stainless steel screen set 15 feet into the water table. The top of the casings will be surveyed for elevation. Locations are:

- One piezometer adjacent to monitor well R-4.
- One piezometer approximately 500 feet north of R-4, in line with Ohio Water Service Company Well Numbers 1, 2, and 3.
- One piezometer between R-4 and Ohio Service Well 4.

Attachment B contains a detailed discussion of the proposed piezometer construction.

Lastly, in response to the above noted conditions and agency concerns, water supply wells 1, 2, 3, and 5 will be sampled for VOC's. Sampling will be on a monthly basis, until the ground water assessment indicates that no impact to these wells exists from the EKCO property.

A schedule for implementation of these additional measures is attached as Attachment C.

REFERENCES

- Inventory of Ohio Soils, Stark County Progress Report No. 29, Ohio Department of Natural Resources, 1968.

- Ohio Water Plan Inventory, Middle Tuscarawas River and Sugar Creek Basins, Under Ground Water Resources, James J. Schmidt, 1962.

- Flow Duration of Ohio Streams, Report No. 3 Ohio Water Plan Inventory, Department of Natural Resources, William Cross, 1959.

- Northeast Ohio Water Plan, Main Report, Ohio Department of Natural Resources, 1972.

ATTACHMENT A

RECEIVED
OCT 12 1987
GEOSCIENCES DEPT

OHIO WATER

OHIO WATER SERVICE COMPANY

123 THIRD STREET S.E.
P.O. BOX 584
MASSILLON, OHIO 44648

October 8, 1987

Mr. L. Sherrerd Steele, Geologist
Geosciences Dept.
Weston Managers
Weston Way
West Chester, PA 19380

Dear Mr. Steele:

In response to your letter of October 5, 1987 I have compiled the enclosed list of address within the areas marked on your maps. This was compiled from our water service account records and a little field checking.

It should be noted that although all the buildings on the list, except one, have water service accounts, there is a very remote possibility that some of them may have a private well as a second source of water. A few of the names marked on your maps are on vacant lots. All residences within the areas marked have been included on my list.

Sincerely,

Donald L. Snyder

Donald L. Snyder
Supervisor of Plans & Estimates

AN AFFILIATE OF

ATTACHMENT B

PIEZOMETER WELL INSTALLATION

EKCO HOUSEWARES, INC.

INTRODUCTION

A total of three (3) piezometer wells will be installed at the EKCO Housewares facility as part of the Phase II site work. The purpose of these wells is to provide information for the interpretation of ground water flow between Ohio Water Service wells 1, 2, 3 and the EKCO facility. These data are required for completion of the Corrective Measures Study presently ongoing.

MONITOR WELL LOCATIONS

The locations of the existing monitor and proposed piezometer wells at the EKCO facility are shown on Figure 1. At each location the wells will intercept the water table and will be completed to approximately 35 to 40 feet below grade.

WESTON

WELL CONSTRUCTION

Figure 2 present a generalized diagram of the piezometer well construction. The wells will be constructed of 2-inch stainless steel wound wire screens and low carbon steel riser pipes. All wells will be installed with a suitable siliceous gravel/sand pack and a bentonite seal. The piezometer will be grouted from the top of the seal to the surface. The well screens will be set approximately three feet above the water table. Each well will have a protective black iron surface casing with a lockable cap. All connections will be screw type and joints will be flush. Only vegetable oil will be used, sparingly, if threads require lubrication. Final depth of each well will be determined by the on-site WESTON geologist.

DRILLING AND WELL INSTALLATION METHODS

The piezometer wells will be installed using hollow stem augers. Split spoon samples (ASTM D1557) for physical description of the sediments will be obtained at five foot intervals at each piezometer location. The on-site geologist will maintain drilling logs and record sediment descriptions. No drilling fluids will be used with the exception of limited amounts of potable water if running sand conditions are encountered.

The total depth of each boring will be determined by WESTON's on-site geologist. At the determined depth, the well screen and riser will be installed and the augers withdrawn to the top of the screen. In this sandy aquifer, natural sand pack will be desirable. However, silica sand will be used to backfill the annular space if natural collapse has left voids after the augers are withdrawn. When plumbing the hole indicates that the sand pack is at the desired height, a bentonite seal will be set as the augers are gradually withdrawn to ensure no further collapse of the borehole. After the bentonite seal is set, the remaining annular space will be grouted with a cement/bentonite (20:1) mix. The grout will be pumped through the augers as they are withdrawn insuring that no collapse occurs. After completion, the grout will be checked for settlement and more grout added, if necessary. The upper 2.5 feet of the annular space will be filled with a cement/sand mix and the protective casing set as shown in Figure 2.

Soil cuttings from the drilling are not expected to be contaminated. Cuttings will be spread at the site or will be removed from the site in order to leave the area in a neat condition.

DECONTAMINATION

The drilling rig, equipment and materials will arrive on site in clean condition. Prior to the start of the drilling, all drill rods, augers, tools, and split spoons will be steam cleaned at an area on-site designated for this purpose. Only potable water will be used. Well screens and pipes will also be cleaned and inspected to ensure that all residue such as machine oils has been removed. At the drilling site, plastic sheeting will be laid down under well pipe and screens to avoid ground contact. Care will be taken to keep all equipment clean before it enters the hole.

Between wells, the development pumps will be cleaned between wells by pumping through a detergent/water solution and then a clear rinse water.

DEVELOPMENT

Each well will be developed with a submersible or suction pump until a steady flow of clear water is obtained and until at least five well volumes are removed. The pump hose shall be capable of reaching the base of the screens and orifice will be moved through the length of the screen during development. Based on experience with other monitor wells at the site, an adequate flow of water is expected to maintain a sufficient head in all wells. However, if a sufficient head cannot be maintained during pumping, purging using a bailer and surge block method may be required.

SAFETY

Ground water contamination is known to be from volatile organics, primarily TCE and TCE in the part per million range. All monitor wells to be installed in this phase, however, are located outside of the plant process area where no soil contamination is anticipated or next to an uncontaminated on-site monitor well. Therefore a level D safety level will be in effect. This includes safety boots, work gloves, overalls and hard hats. Air monitoring however, will be done and, if organics are detected, work will be performed in Level C.

ATTACHMENT C

SCHEDULE FOR IMPLEMENTATION OF ADDITIONAL INTERIM MEASURES, EKCO PLANT, MASSILLON, OHIO

ATTACHMENT C

SCHEDULE FOR IMPLEMENTATION OF ADDITIONAL INTERIM MEASURES, EKCO PLANT, MASSILLON, OHIO

Schedule

1. Increased pumpage of W-10:

   A. Receive 400 gpm pump - week of 3/7/88
   B. Install new pump - week of 3/14/88
   C. Pump test to establish optimum pump rate - weeks of 3/21/88 and 3/28/88
   D. Operational - week of 4/4/88

2. Sampling of Ohio Water Company well #1, 2, 3, and 5:

   A. Begin monthly sampling of wells - week of 2/8/88
   B. Sample monthly - second week of each month
   C. Reassess sampling schedule after receipt of three round of analytical results

3. Installation of 3 piezometers

   A. Obtain access to neighboring properties: If access cannot be obtained by EKCO by 1 March, USEPA will be requested to assist in obtaining access
   B. Mobilize well drillers - within 3 weeks of obtaining property access
   C. Drilling and installation - 1 week
   D. Survey and water level measurements - 1 week following installation